



Natural Resources
Canada

Ressources naturelles
Canada

**GEOLOGICAL SURVEY OF CANADA
OPEN FILE 8702**

**A reassessment of Mesozoic–Cenozoic seabed samples of
bedrock from the western Davis Strait and eastern Baffin
Island margin, offshore Nunavut: new insights into their
lithology, age, and paleoenvironment of deposition**

L.T. Dafoe and G.L. Williams

2020

Canada



GEOLOGICAL SURVEY OF CANADA OPEN FILE 8702

A reassessment of Mesozoic–Cenozoic seabed samples of bedrock from the western Davis Strait and eastern Baffin Island margin, offshore Nunavut: new insights into their lithology, age, and paleoenvironment of deposition

L.T. Dafoe and G.L. Williams

Geological Survey of Canada, 1 Challenger Drive, Dartmouth, Nova Scotia B2Y 4A2

2020

© Her Majesty the Queen in Right of Canada, as represented by the Minister of Natural Resources, 2020

Information contained in this publication or product may be reproduced, in part or in whole, and by any means, for personal or public non-commercial purposes, without charge or further permission, unless otherwise specified.

You are asked to:

- exercise due diligence in ensuring the accuracy of the materials reproduced;
 - indicate the complete title of the materials reproduced, and the name of the author organization; and
 - indicate that the reproduction is a copy of an official work that is published by Natural Resources Canada (NRCan) and that the reproduction has not been produced in affiliation with, or with the endorsement of, NRCan.
- Commercial reproduction and distribution is prohibited except with written permission from NRCan. For more information, contact NRCan at nrcan.copyrightdroitdauteur.nrcan@canada.ca.

Permanent link: <https://doi.org/10.4095/321758>

This publication is available for free download through GEOSCAN (<https://geoscan.nrcan.gc.ca/>).

Recommended citation

Dafoe, L.T. and Williams, G.L., 2020. A reassessment of Mesozoic–Cenozoic seabed samples of bedrock from the western Davis Strait and eastern Baffin Island margin, offshore Nunavut: new insights into their lithology, age, and paleoenvironment of deposition; Geological Survey of Canada, Open File 8702, 1 .zip file.
<https://doi.org/10.4095/321758>

Publications in this series have not been edited; they are released as submitted by the author.

INTRODUCTION

The Labrador–Baffin Seaway represents a Mesozoic–Cenozoic rift system that formed the Labrador Sea, Davis Strait and Baffin Bay (Fig. 1) as the Greenland and North American plates separated. This rift system initiated in the Early Cretaceous (Roest and Srivastava, 1989) with the onset of seafloor spreading beginning during the Maastrichtian (chron C31) along the central Labrador margin (Keen et al., 2018a), and regionally in the Labrador–Baffin Seaway by the Danian (chron C27n; Oakey and Chalmers, 2012; Keen et al., 2018b). Major volcanism in the Davis Strait region began about the same time as the onset of regional seafloor spreading around 61 Ma, due to the arrival of a mantle plume in the area (Storey et al., 1998, 2007; Larsen et al., 2009). This resulted in significant basalt accumulations in the central part of the Labrador–Baffin Seaway. Subsequent major strike-slip motion in the Davis Strait region between chrons C25n and C24n in the latest Thanetian was the result of a change in the spreading direction between North America and Greenland to a more north–south orientation (Oakey and Chalmers, 2012). This transform motion resulted in the formation of the Davis Strait High (Fig. 1; Srivastava et al., 1982), a major structure thought to be composed of Precambrian basement rock with a relatively thin basalt cover, based on refraction velocities (Suckro et al., 2013). Finally, seafloor spreading ended by chron C13 near the Eocene–Oligocene boundary (Oakey and Chalmers, 2012).

The tectonic evolution of the Labrador–Baffin Seaway influenced the formation of basins and accumulation of Mesozoic–Cenozoic strata sampled by exploration wells along the Labrador margin (Dickie et al., 2011) and central and northern West Greenland margin (Gregersen et al., 2019). However, in western Davis Strait and along the eastern Baffin Island margin, there is very limited sampling and understanding of the rift-related stratigraphy. Three wells in the northern portion of the Saglek Basin, western Davis Strait, intersect Paleocene and younger rocks (Hekja O-71, Raleigh N-18, and Gjoa G-37; Fig. 1; Klose et al., 1982; Nøhr-Hansen et al., 2016). Farther north, the ODP Site 645 corehole represents the only sampling of significant subsurface strata from western Baffin Bay: intersecting Miocene and younger strata (Fig. 1; Srivastava et al., 1987; Dafoe and Williams, 2020).

In light of the lack of subsurface sampling of both the western Davis Strait area and eastern Baffin Island margin, the Geological Survey of Canada (GSC) conducted seven marine cruises from 1974 to 1985 during which several bedrock outcrops near the seafloor were drilled to collect samples of basement, pre-rift sedimentary strata, and rift-related rocks. Drilling operations were variably successful as jamming and overburden material resulted in significant challenges to recovering bedrock (e.g. MacLean et al., 1977). Less often, bedrock was also recovered from dredges and as fragments within piston core samples. Results were published in several papers and reports following their acquisition (*see* references in the results section below). A follow-up study by MacLean et al. (2014) presented new analyses on many of the sedimentary intervals collected from the western Davis Strait and eastern Baffin Island margin with a focus on the palynological age, paleoenvironments, and potential source rock properties.

In this study, we present a compilation and summary of all of the bedrock material collected by the GSC in the western Davis Strait and western Baffin Bay region. The Mesozoic and Cenozoic sedimentary intervals and basalt samples were reassessed to determine if further information could be obtained on the lithologies, ages and paleoenvironments of deposition, specifically with a focus on new sedimentological and ichnological observations to enhance paleoenvironmental interpretations, as well as providing new palynological age dates from key samples from the floor of Scott Trough.

MATERIALS AND METHODS

The 66 drill core, dredge and piston core samples of bedrock reported on in this study were collected during marine cruises conducted by the GSC-Atlantic from 1974 to 1985, and are curated at the GSC, Atlantic office in Dartmouth, Nova Scotia. Detailed information on these marine cruises (i.e. cruise reports) and the samples can be found on the Expedition Database (<http://ed.gdr.nrcan.gc.ca>), and the location and technical information in the tables in this study are derived from that database. Samples are labelled according to cruise and station number. The first two digits of the cruise number represent the year the cruise was conducted, and each sample was assigned an original sample station number. Accordingly, a sample collected at station number 109 during cruise 80028 in 1980 is shown as 80028-109. The bedrock corehole samples are 2.54 cm in diameter, are typically a few centimetres to a few tens of centimetres in length, and can include overburden material sampled during the bedrock coring process (the overburden is not taken into account in the reported length of bedrock collected). Due to previous sub-sampling, our study was often hampered by the lack of remaining rock material. In the original cruise reports, scientific reports and papers, multiple lines of evidence were used to conclude that bedrock was encountered: the nature of the material (lack of obvious weathering, fragile, poorly consolidated), expected bedding orientation, material that did not appear to be sampled clasts (i.e. core fragments without rounded edges and that completely fill the entire width of the core barrel), drilling rate encountered during drill core operations, as well as the same rock type collected in multiple drill holes that were in close proximity to one another. We note only one interval (80028-58) that may not be from in-place bedrock, based on our new analyses.

Sedimentary bedrock samples were reassessed in this study from a lithological, sedimentological and ichnological (trace fossil) perspective, where possible. We use the ichnofacies model for the Western Interior Seaway from Pemberton et al. (2001) that was modified to include slope and deeper-water settings by Dafoe and Williams (2020). Due to the general lack of remaining material and the narrow profile of the drill core samples, it was difficult to assess sedimentary structures and trace fossils. However, some material was highly bioturbated and/or preserved structures that had not been previously described. Basalt bedrock samples were also studied including the colouration, texture, and degree of weathering. In some cases, our study provides more detailed descriptions of the rocks that have not been previously published.

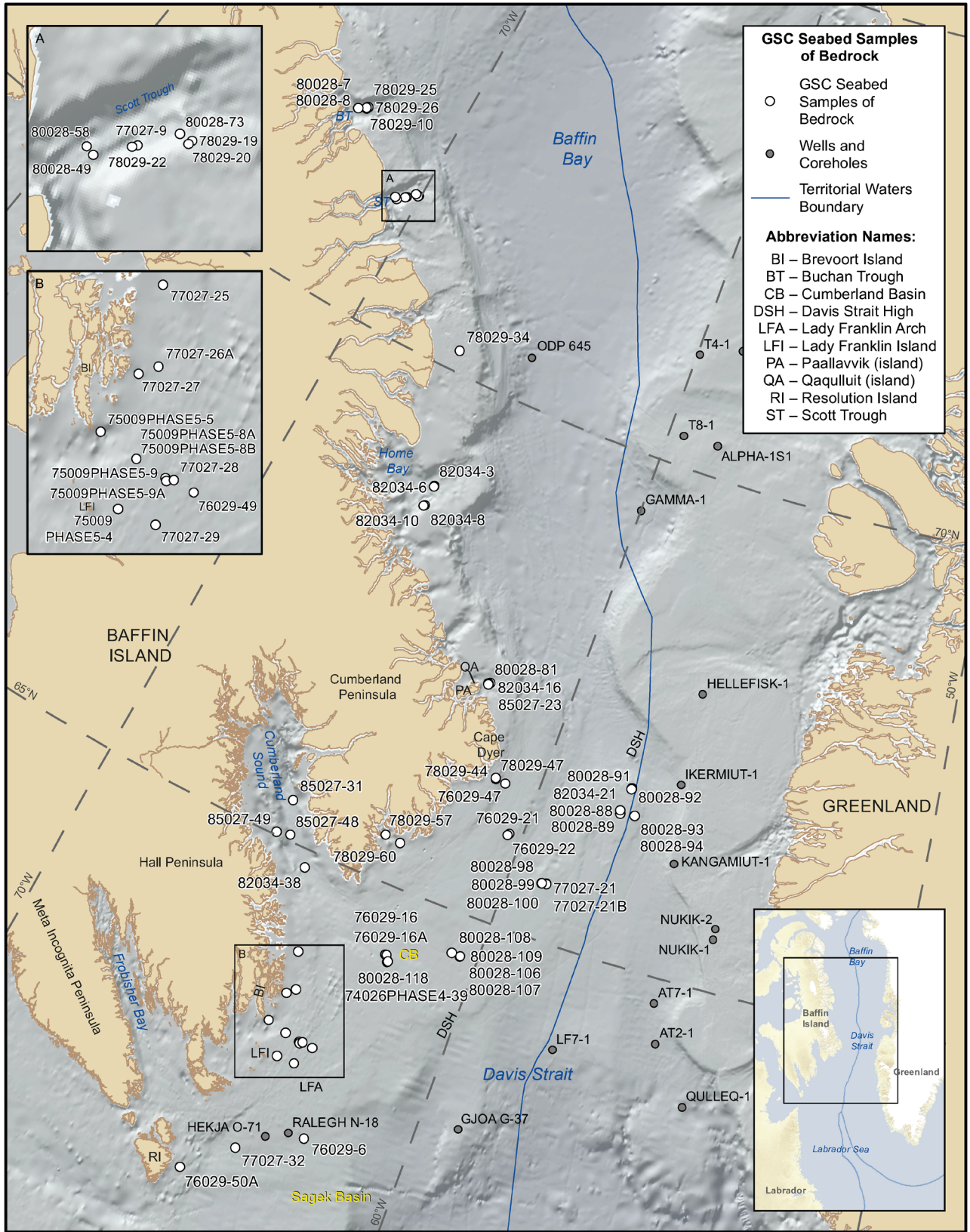


Figure 1: Map of the study region showing the location of GSC samples of bedrock. Bathymetry from GEBCO (2014).

Palynological processing of samples from two bedrock intervals assessed in this study was conducted by Global Geolabs Ltd in Medicine Hat, Alberta. The samples were crushed and then treated with hydrochloric and hydrofluoric acids to remove carbonates and silicates, respectively. Thorough rinsing with distilled water took place between each of these steps. A subsequent treatment of hot, concentrated hydrochloric acid was applied and then the samples were centrifuged to remove the acid. The remaining fractions were further concentrated by centrifuging in heavy liquid zinc bromide, after which a representative fraction of each sample was used to make a kerogen slide. Following this stage, the samples were oxidized with Schulze solution and then placed in a 10% solution of ammonium hydroxide for about five minutes. Following this step, Safranin red was added to stain the material and then a second (unsieved) slide was prepared for palynomorph counts to determine variations in abundances of taxa. The next step involved sieving the samples through a 30 µm sieve to concentrate dinocysts and larger miospores. Separate slides were then prepared from both the +30 and -30 µm fractions. The residues were smeared on a coverslip, dried, and then inverted and placed on a slide using clear casting resin as the mounting medium. The palynology slides used in this study are curated at the Geological Survey of Canada (Atlantic), Dartmouth, Nova Scotia. Photographs of specimens were taken using a Zeiss Photomicroscope, generally with a 50x objective.

The bedrock samples are generally marine in nature, and ages for the Mesozoic and Cenozoic strata are primarily based on dinocysts, which provide more precise age and paleoenvironmental determinations in those strata, rather than pollen and spores (*see* Nøhr-Hansen et al., 2016). As the bedrock is in situ, both first or oldest occurrences (FO) and last or youngest occurrences (LO) can be used for most age determinations.

RESULTS

BASEMENT ROCKS

Several drill cores of pre-rift basement rock were collected from the western Davis Strait and eastern Baffin Island margin and were initially described as metamorphic rock, and sometimes more specifically as gneisses (MacLean and Falconer, 1977; MacLean, 1978; MacLean and Falconer, 1979; MacLean et al., 1981; MacLean et al., 1986). These materials are not reassessed in this study; however, a compilation of the rocks is presented in Table 1 and locations are shown in Figure 1, with published descriptions and other analytical results.

PRE-RIFT SEDIMENTARY STRATA

Several carbonate drill cores were collected from the western Davis Strait, offshore the Hall Peninsula and southwest of Cumberland Sound (Jansa, 1976; MacLean et al., 1977; MacLean, 1978; Bingham-Koslowski, 2018). The carbonates were generally reported as Ordovician (MacLean et al., 1977; MacLean, 1978), reflecting a pre-rift sedimentary succession and re-described in detail in Bingham-Koslowski (2018). These materials are not reassessed in this study; however, a compilation of the rocks is presented in Table 2 and locations are shown in Figure 1, with published descriptions and other analytical results.

BASALTS

A total of 17 drill core samples, originally described as basalt bedrock (MacLean, 1977; MacLean and Falconer, 1977; MacLean et al., 1978; MacLean, 1980; MacLean and Williams, 1983), were analyzed in the present study. A summary of the key information is presented in Table 3. In the following sections, we present previous descriptions and interpretations of each drill core sample, followed by our observations and interpretations. We discuss the basalt samples according to their general location in the western Davis Strait region for the following sub-regions: offshore Cape Dyer, central Davis Strait, offshore Cumberland Peninsula, and offshore Cumberland Sound.

Offshore Cape Dyer

Three basalt drill cores were collected near Cape Dyer (Fig. 1), a locality known to have onshore early Cenozoic basalt outcrops near the coastline (Clarke and Upton, 1971).

76029-21

Drill core 76029-21 was described by MacLean and Falconer (1977) as 13 cm of reddish brown, aphanitic basalt with zeolite-mineral infilled vesicles. MacLean et al. (1978) further indicated that the rock was highly amygdaloidal and oxidized, suggesting that it may have come from near the top of a basalt flow. We agree with this interpretation and similarly observe the reddish colouration and highly amygdaloidal to vesicular character with needle-like to tabular white minerals (possibly stilbite) infilling vesicles (Fig. 2A). There is a general lack of weathering, suggesting the in-situ nature of the bedrock.

76029-22

Another basalt drill core was recovered close to site 76029-21 also during cruise 76029 at station 22 and consists of 37 cm of dark grey, aphanitic basalt with zeolite-filled vesicles (MacLean and Falconer, 1977), and is thought to have been from a basalt flow (MacLean et al., 1978). We also observe a difference in colouration (grey; Fig. 2B) as compared to 76029-21 (reddish brown) for this aphanitic to amygdaloidal basalt. The amygdales are small (up to 3 mm in diameter), with some vesicles still unfilled. The abundance of vesicles is less compared to 76029-21, and may indicate a location at depth within a basalt flow.

76029-47

Closer to Cape Dyer, drill core 76029-47 recovered 37 cm of aphanitic and vesicular, dark grey basalt (MacLean and Falconer, 1977). This basalt is, however, coarser grained and less altered as compared to 76029-21 and -22 (MacLean et al., 1978). Based on K-Ar age dating of a whole rock sample, MacLean and Falconer (1977) determined a Late Cretaceous to early Tertiary age, which was refined with more reliable Ar-Ar age dating by Williamson et al. (2000) to 62.9 +/- 2.5 Ma (Danian). We further note large vesicles (1–10 mm in diameter) with a locally amygdaloidal character (Fig. 2C). The coarser grained texture includes small clusters of black, needle-shaped crystals within the vesicles, as well as black phenocrysts that are locally present, possibly amphibole. The size of vesicles and their general abundance may indicate a position near the top of a basalt flow.

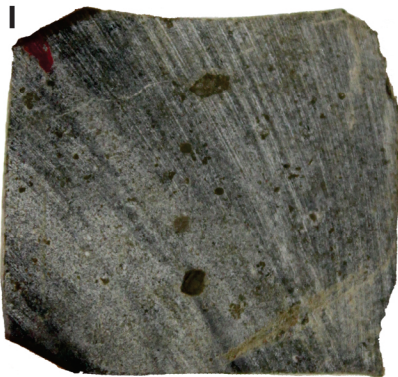
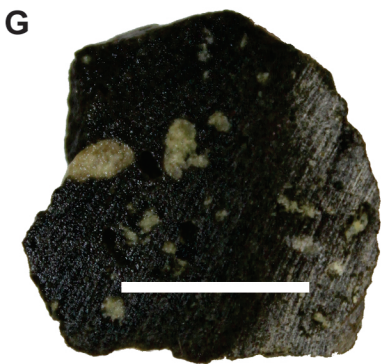
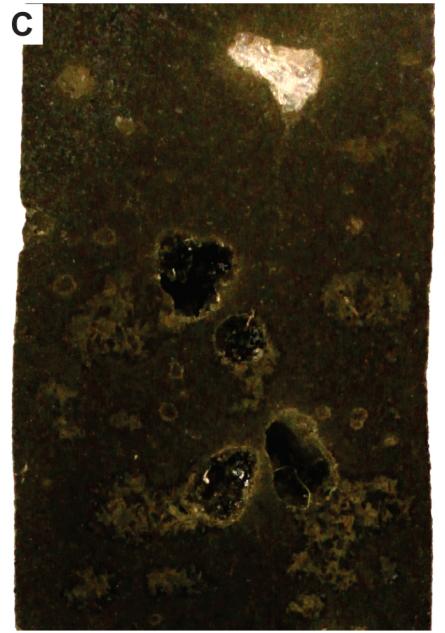
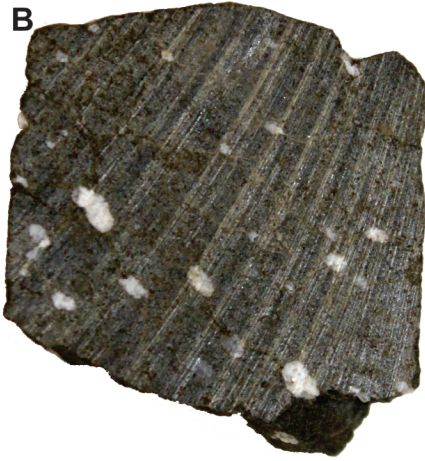


Figure 2 (previous page): Basalt drill core samples from the Cape Dyer (A-C) and central Davis Strait (D-K) regions: A) 76029-21, B) 76029-22, C) 76029-47, D) 80028-88, E-F) 80028-89, G) 80028-91, H) 80028-92, I-J) 80028-94, K) 82034-21. The full width of all drill cores is 2.54 cm, but the scale bar in 'G' is 1 cm.

Central Davis Strait

Seven basalt bedrock drill cores were recovered from the central Davis Strait region (Table 3) lying above the northern portion of the Davis Strait High (Fig. 1).

80028-88

The drill core at station 88, cruise 80028, consists of 43 cm of basalt (MacLean, 1980), but has not been described further. We consider the texture to be mostly aphanitic and only locally amygdaloidal or porphyritic, with small black phenocrysts in the grey basalt (Fig. 2D). Notably, a red, rust-coloured mineral is present within the basalt and white zeolite minerals (possibly stilbite) infill larger vesicles. The aphanitic nature of the basalt appears to indicate a position at depth within a basalt flow.

80028-89

In close proximity to 80028-88, station 89 recovered a 27 cm long basalt interval (MacLean, 1980). In this study, the texture is noted as aphanitic to amygdaloidal upwards with small (1 mm sized) amygdales filled with a non-calcareous, white mineral (Fig. 2E, F). The progression from dark grey, aphanitic to amygdaloidal basalt appears to indicate a progression through a single flow, approaching the flow top near the top of the bedrock interval.

80028-91

To the northeast of stations 88 and 89, 7.5 cm of basalt was recovered from 80028-91 (MacLean, 1980). Here we describe the dark grey basalt as amygdaloidal to vesicular with vesicles 1–4 mm in size (Fig. 2G). Amygdales are again infilled with a white mineral, possibly stilbite. The basalt is likely from near the top of a flow, based on the texture.

80028-92

In proximity to station 91, 16 cm of basalt were sampled at 80028-92 (MacLean, 1980; Williamson et al., 2000). This rock was dated using Ar-Ar of a whole-rock sample at 55.1 +/- 2.3 Ma (early Ypresian) by Williamson et al. (2000). In our study, the basalt is further described as dark grey, aphanitic to brecciated and is lacking vesicles, as well as the amygdaloidal texture noted in 80028-91 (Fig. 2H). Notably, rimmed green 'clasts', angular black (basaltic) fragments, and red mineral crystals are present. The texture is possibly indicative of a more subaqueous setting in which quenching could have resulted in the rimmed nature of 'clasts' and the brecciated texture from reworking.

80028-93

An additional 21 cm of basalt were recovered from the same region at 80028-93 (MacLean, 1980). Unfortunately, little of the bedrock material remains for assessment due to previous sampling of the

drill core. The remnants of basalt appear to be aphanitic, possibly indicating a position near the base of a flow.

80028-94

To the south of station 92 and just over the international boundary between Canada and Greenland, 80028-94 collected 17 cm of basalt (MacLean, 1980). We observe that the dark grey basalt is aphanitic with relatively large, rimmed vesicles (1–6 mm in size) with some partially filled by a white mineral (Fig. 2I, J). The size of the vesicles suggests a location from near the top of a basalt flow.

82034-21

A 14 cm of basalt bedrock drill core was collected near samples 88028-88 and -89 at station 21 for cruise 82034 (MacLean and Williams, 1983). We note that the basalt is dark grey and aphanitic with rare amygdales suggesting that it was derived from within a basalt flow (Fig. 2K).

Offshore Cumberland Peninsula

Offshore Cumberland Peninsula, in the western Davis Strait, a cluster of five drill core samples of basalt bedrock were recovered from atop the Davis Strait High (Table 3; Fig. 1).

77027-21

At the eastern edge of the cluster of stations, drill core 77027-21 was described by MacLean (1977) as 12 cm of possible basalt bedrock. We describe this basalt as grey and aphanitic (Fig. 3A), and it could be from the lower part of a basalt flow where there is less gas trapped in the lava.

77027-21B

Nearby to station 21, 77027-21B recovered 12.5 cm of dark grey, aphanitic basalt (MacLean, 1978). In addition to the aphanitic texture, our study reveals a porphyritic texture related to small, black to brown phenocrysts that could be amphibole or pyroxene (Fig. 3B). Again, this aphanitic basalt sample appears to be from the lower part of a basalt flow.

80028-98

Just east of the drill core stations from cruise 77027, 80028-98 sampled 5 cm of possible bedrock (MacLean, 1980). Unfortunately, the core is in poor condition and we can only further note that the material is composed of rubbly, green to black, small, aphanitic basalt fragments (Fig. 3C). The texture suggests a position near the base of a basalt flow.

80028-99

Adjacent to station 98, 80028-99 sampled 17 cm of possible basalt bedrock (MacLean, 1980). Here, we further observe that the drill core is composed of aphanitic, dark grey basalt that lacks any evidence of weathering (Fig. 3D). The aphanitic nature of the basalt suggests a position near the base of a basalt flow.

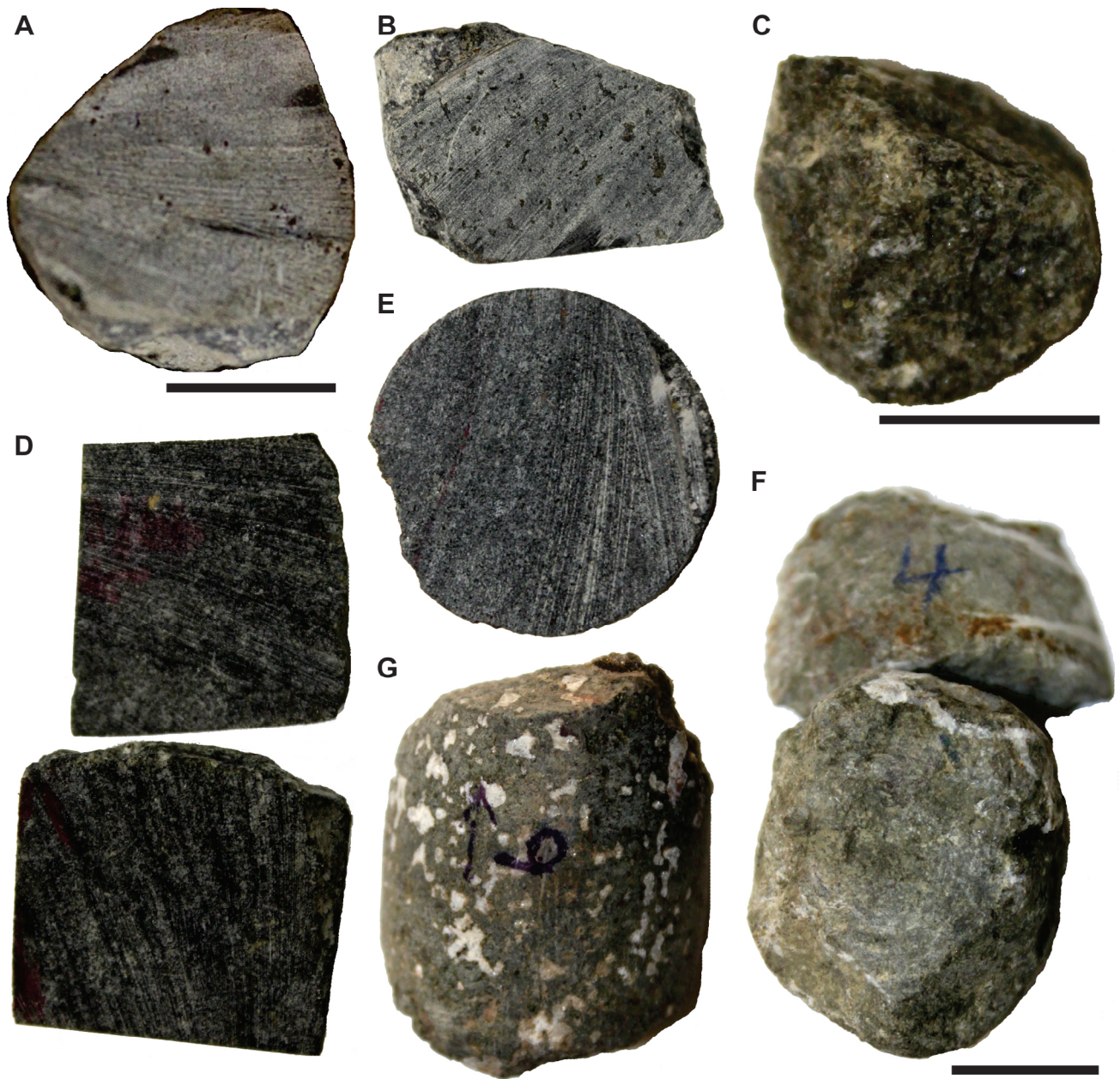


Figure 3: Basalt drill core samples from the southwest central Davis Strait (A-E) and Cumberland Sound (F-G) regions: A) 77027-21, B) 77027-21B, C) 80028-98, D) 80028-99, E) 80028-100, F) 80028-106, G) 80028-107. The full width of all drill cores is 2.54 cm, but the scale bars in 'A', 'C', and 'F' are 1 cm.

80028-100

In approximately the same location as stations 98 and 99, 80028-100 sampled 16 cm of possible basalt bedrock (MacLean, 1980). We further describe the rock as medium-grey, aphanitic basalt that appears to be plagioclase-rich (Fig. 3E). Similar to the other samples in this region, the aphanitic texture indicates a position near the base of a basalt flow.

Offshore Cumberland Sound

Near the southern end of the Davis Strait High and offshore Cumberland Sound, two additional drill cores of basalt bedrock were recovered during cruise 80028 (Table 3; Fig. 1).

80028-106

An 18 cm drill core of basalt or volcanic rock was collected from station 106 during cruise 80028 (MacLean, 1980; MacLean et al., 1982). We further describe the rock as medium grey, aphanitic basalt with some white mineralizations within fractures (Fig. 3F). The aphanitic texture indicates a position near the base of a basalt flow.

80028-107

Adjacent to station 106, station 80028-107 recovered 13 cm of basalt or volcanic rock (MacLean, 1980; MacLean et al., 1982). The drill core has been highly sampled with only two remaining core pieces bearing a very similar texture to 80028-106, suggesting that these core pieces are the remnants of the bedrock interval. In this study, the texture of the dark grey basalt is described as amygdaloidal with white to pink minerals, consisting of predominantly zeolite minerals with some calcite present (Fig. 3G). The texture is indicative of a position near the top of a basalt flow where more gas was trapped during crystallization.

RIFT-RELATED SEDIMENTARY ROCKS

We studied 29 samples of sedimentary bedrock (24 drill cores, two dredge samples, and fragments within three piston cores) related to the opening of the Labrador–Baffin Seaway. A summary of the key information is presented in Table 4 and locations are shown in Figure 1. In the following sections, we describe the previous descriptions and interpretations of each drill core sample, followed by our observations and interpretations. The bedrock samples are described in an order based on their age, or presumed age and association with similar rocks in the region.

Lower Cretaceous Rocks in the Cumberland Sound Area

Three samples (two drill cores and bedrock fragment in a piston core) of Lower Cretaceous bedrock were collected from Cumberland Sound and a fourth was collected outside the sound (Table 4; Fig. 1).

74026Phase4-39

Outside the mouth of Cumberland Sound, an 18 cm, well-consolidated sandstone drill core was recovered from 74026Phase4-39 (Srivastava, 1974). The age was determined to be late Albian–Cenomanian (Williams, pers. comm., in MacLean et al., 1977; unpublished data by Williams, reported in MacLean et al., 2014). No paleoenvironment of deposition was described for this sample. We have not been able to locate this core for re-evaluation.

82034-38

The drill core at 82034-38, near the mouth of Cumberland Sound, sampled 6 cm of dark grey, semi-consolidated mudstone to dark-grey to black shale with terrestrially sourced organic matter (MacLean and Williams, 1983; MacLean et al., 2014). The age of the rock was determined by MacLean and Williams (1983) to be Aptian–Cenomanian, but was later revised to Early Cretaceous by MacLean et al. (2014), who further indicated that reworking could account for the age. No paleoenvironmental interpretation was initially provided for this mudstone to shale interval. We describe the dark grey mudstone as micro-micaceous and non-calcareous (Fig. 4A). Our results suggest that it represents a quiet-water setting that allowed for deposition of clays from suspension.

85027-31

The piston core taken at 85027-31 in northeast Cumberland Sound contains fragments of bedrock composed of friable black shale, mudstone and siltstone fragments with coaly detritus (MacLean et al., 1986, 2014). The age determined from these fragments was thought to be similar to 85027-48 (Barremian–Aptian; MacLean et al., 1986), and MacLean et al. (2014) later confirmed an Early Cretaceous, Barremian–Albian age, but with supporting evidence for an Aptian–middle Albian age. MacLean et al. (1986, 2014) suggested a nonmarine setting in proximity to a shoreline or possibly marginal marine. In our study, we observe that most of the bedrock fragments were sub-sampled with only one dark grey shale fragment preserved in the archived half of the piston core (Fig. 4C). From the lithology of this fragment, a quiet-water setting is evident, possibly floodplain or lagoonal based on the previous palynomorph assessment.

85027-48

South of station 31, drill core 85027-48 was initially described as 9 cm of dark grey, semi-consolidated mudstone to dark grey to black shale (MacLean et al., 1986; MacLean et al., 2014). The age was initially considered to be Barremian–Aptian (MacLean et al., 1986), was but later revised to Aptian–Albian (MacLean et al., 2014). Based on their palynological assessment, MacLean et al. (2014) considered the paleoenvironment to be nonmarine, but possibly in close proximity to a shoreline. There is little left of the original core material, aside from a bag of fragments/sediment, due to extensive previous sampling (Fig. 4B). The only additional insights from this study are that the mudstone is friable and similar fragments were collected in the overburden, including a black, organic-rich mudstone. Without more information from the remaining material, we can only postulate a quiet-water setting that could be either floodplain or lagoonal based on the previous palynological results.

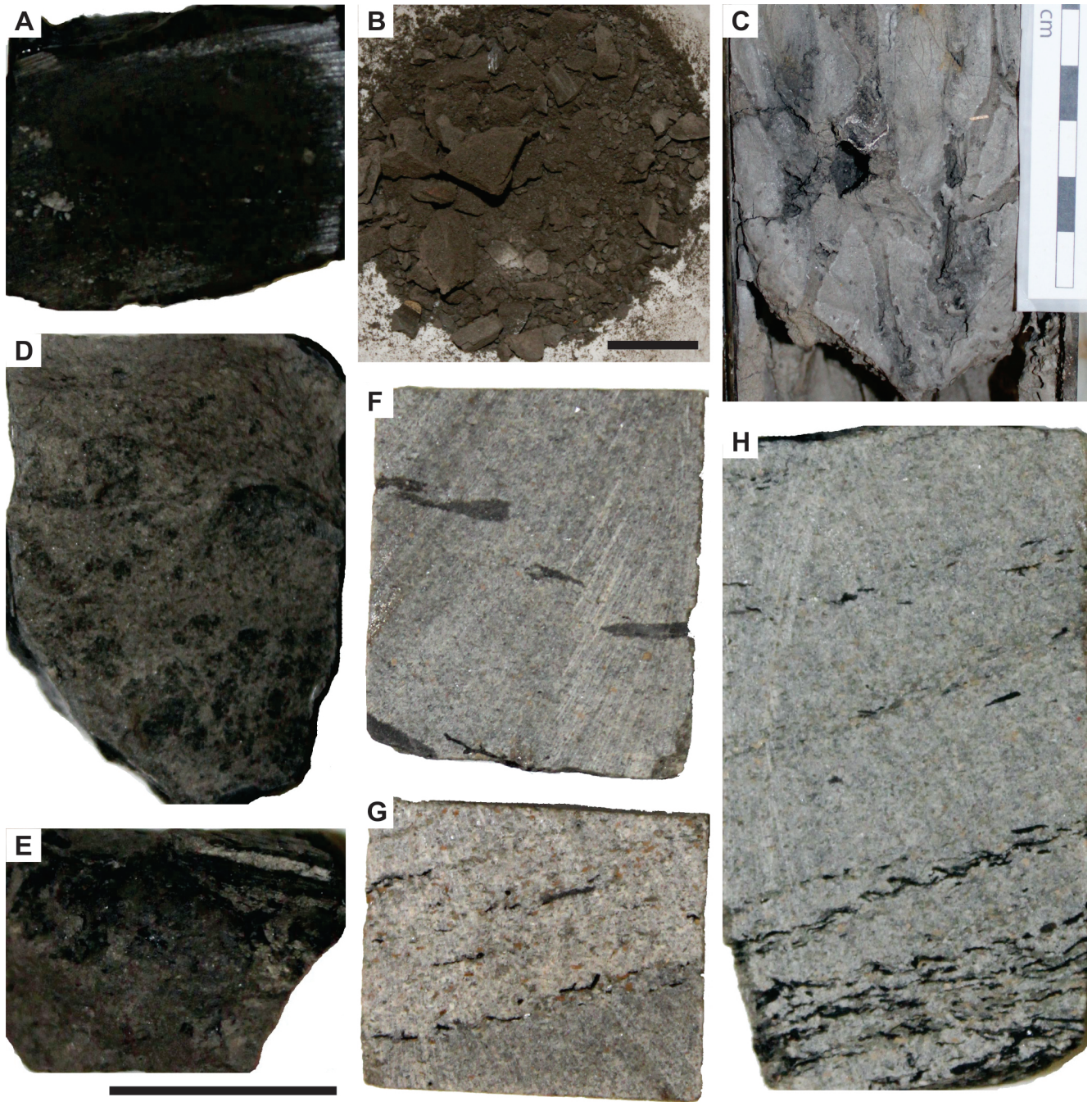


Figure 4: Lower Cretaceous sedimentary bedrock samples from Cumberland Sound (A-C) and the Paallavik (island) area (D-H). A) Mudstone from 82034-38. B) Mudstone fragments from 85027-48. C) Shale fragment (approximately in the centre of photo) in piston core mud interval from 85027-31. D) Mottled or deformed mudstone from 80028-81. E) Mudstone with thin sandstone laminae from 82034-16. F) Sandstone interval with mudstone rip-up clasts from 85027-23. G-H) Organic detritus in cross-bedded sandstone from 85027-23. The full width of all drill cores is 2.54 cm, but the scale bars in 'B' and 'E' are 1 cm.

Lower Cretaceous Rocks in the Paallavik (Island) Area

Just offshore of Paallavik (island), three drill cores were collected during three separate cruises, with all of them sampling Lower Cretaceous rocks (Table 4; Fig. 1).

80028-81

Similar to the samples from Cumberland Sound, 80028-81 recovered a dark grey, silty mudstone drill core (MacLean, 1980; MacLean et al., 2014). MacLean et al. (2014) determined a late Albian age and nonmarine setting for the rock. Our results show a moderately-consolidated, dark grey, muddy siltstone with faint laminations and rare mottling and organic detritus (Fig. 4D). Scattered small granules and granitic pebbles are also present. The predominance of silt and clay indicates a quiet-water setting, but the presence of granules and small pebbles indicates periodic higher-energy conditions. Our lithological observations in combination with the nonmarine setting suggested by palynomorphs, indicates that a floodplain is the most likely paleoenvironment of deposition.

82034-16

In close proximity to 80028-81, another bedrock drill core was collected during cruise 82034 at station 16. This material was also reported as semi-consolidated, fine-grained clastic sedimentary rock with coal fragments (MacLean and Williams, 1983; MacLean et al., 2014). The age was given as Albian (MacLean and Williams, 1983), but revised to Aptian to middle Albian (MacLean et al., 2014). Similar to the mudstones in Cumberland Sound, 82034-16 was found to be nonmarine, but in possible proximity to a shoreline (MacLean and Williams, 1983; MacLean et al., 2014). We further note very fine-grained sandstone laminae in the dark grey mudstone drill core (Fig. 4E). There were no other clues to the paleoenvironment other than indications of a quiet-water setting due to the generally fine-grained nature of the rock. In conjunction with the previous palynological analyses, a floodplain or lagoonal setting is postulated.

85027-23

Drill core 85027-23 sampled 117 cm of well-consolidated, calcareous sandstone offshore Paallavik (island; MacLean, 1985; MacLean et al., 2014). The age of this rock is unknown, but it may be related to the Neocomian–Aptian white sandstones of the Quqaluit Formation on nearby Qaqulluit (island; Burden and Langille, 1990, 1991; MacLean et al., 2014). There is no previous interpretation of the paleoenvironment. We further describe this core as silty, light to medium grey, very fine-grained sandstone (Fig. 4F, G, H). Tabular cross-bedding is common (Fig. 4G, H), with lesser planar laminations, rare massive bedding, and a possible instance of wave-rippled strata. Mudstone rip-up clasts are also scattered (Fig. 4F) and organic detritus is common (Fig. 4G, H). The prevalence of cross-bedding suggests migrating dune forms in a high-energy setting. Organic detritus indicates a nearby terrestrial source while mudstone rip-up clasts may reflect eroded banks or flood plains. The possible wave-ripple cross-stratification may suggest a shallow marine origin. The setting was either fluvial or shallow marine, again consistent with the Quqaluit Formation onshore (Burden and Langille, 1990).

Upper Cretaceous Rocks in Home Bay

In the Home Bay area, four drill cores sampled Upper Cretaceous rocks in two general locations (Table 4; Fig. 1).

82034-3

Station 3 from cruise 82034 collected a 19 cm drill core of semi-consolidated, dark grey mudstone, siltstone, and sandstone (MacLean and Williams, 1983; MacLean et al., 2014). The age was determined as Campanian (MacLean and Williams, 1983), and later revised to late Santonian–early Campanian with the depositional setting interpreted as middle shelf (MacLean et al., 2014). We further note minor mica content in the brown mudstone, but due to the limited material left of the bedrock sample, only a quiet-water setting can be suggested (Fig. 5A). This interpretation fits with the mid-shelf interpretation from the previous palynological analyses.

82034-6

In close proximity to 82034-3, station 6 sampled 1 cm of bedrock described as semi-consolidated dark grey mudstone, siltstone, and sandstone (MacLean and Williams, 1983; MacLean et al., 2014). Only one, small, siltstone fragment remains of the material and no other information could be gained from the present study. There are no previous interpretations of the paleoenvironment.

82034-8

Close to stations 3 and 6, drill core 82034-8 consists of 15 cm of semi-consolidated, organic-rich mudstone with a petroliferous odour (MacLean and Williams, 1983). This core was dated Late Cretaceous (MacLean and Williams, 1983), but the age was refined to Santonian by MacLean et al. (2014). MacLean and Williams (1983) and MacLean et al. (2014) interpreted the presence of dinocysts to suggest a marine depositional setting. The dark grey, friable nature of the mudstone is noted here, however, epoxy resin on the core surfaces makes any further observations in this study difficult (Fig. 5B). The lithology is consistent with a quiet-water setting, which could indicate a lagoonal or shelfal setting, with shelfal more likely based on the findings from 82034-3.

82034-10

Station 10 of cruise 82034, also in Home Bay, collected a 17 cm drill core of semi-consolidated, dark grey mudstone, siltstone, and sandstone (MacLean and Williams, 1983; MacLean et al., 2014). Similar to the other bedrock samples in the area, MacLean and Williams (1983) determined a Late Cretaceous age and a marine depositional setting based on the presence of dinocysts. We similarly note very fine-grained, grey, muddy sandstone with planar lamination, organic detritus, mudstone laminae and rare mica grains (Fig. 5C). We agree with a marine setting and suggest a possible deltaic paleoenvironment based on the abundance of organic detritus, the heterolithic nature of the sediment, and a lack of infaunal reworking.

Upper Cretaceous Rocks in Scott and Buchan Troughs

Further north along the eastern Baffin Island margin, bedrock fragments of Late Cretaceous age were recovered near the base of a piston core from Scott Trough, and five drill cores from Buchan Trough sampled additional Upper Cretaceous rocks in that region (Table 4; Fig. 1).

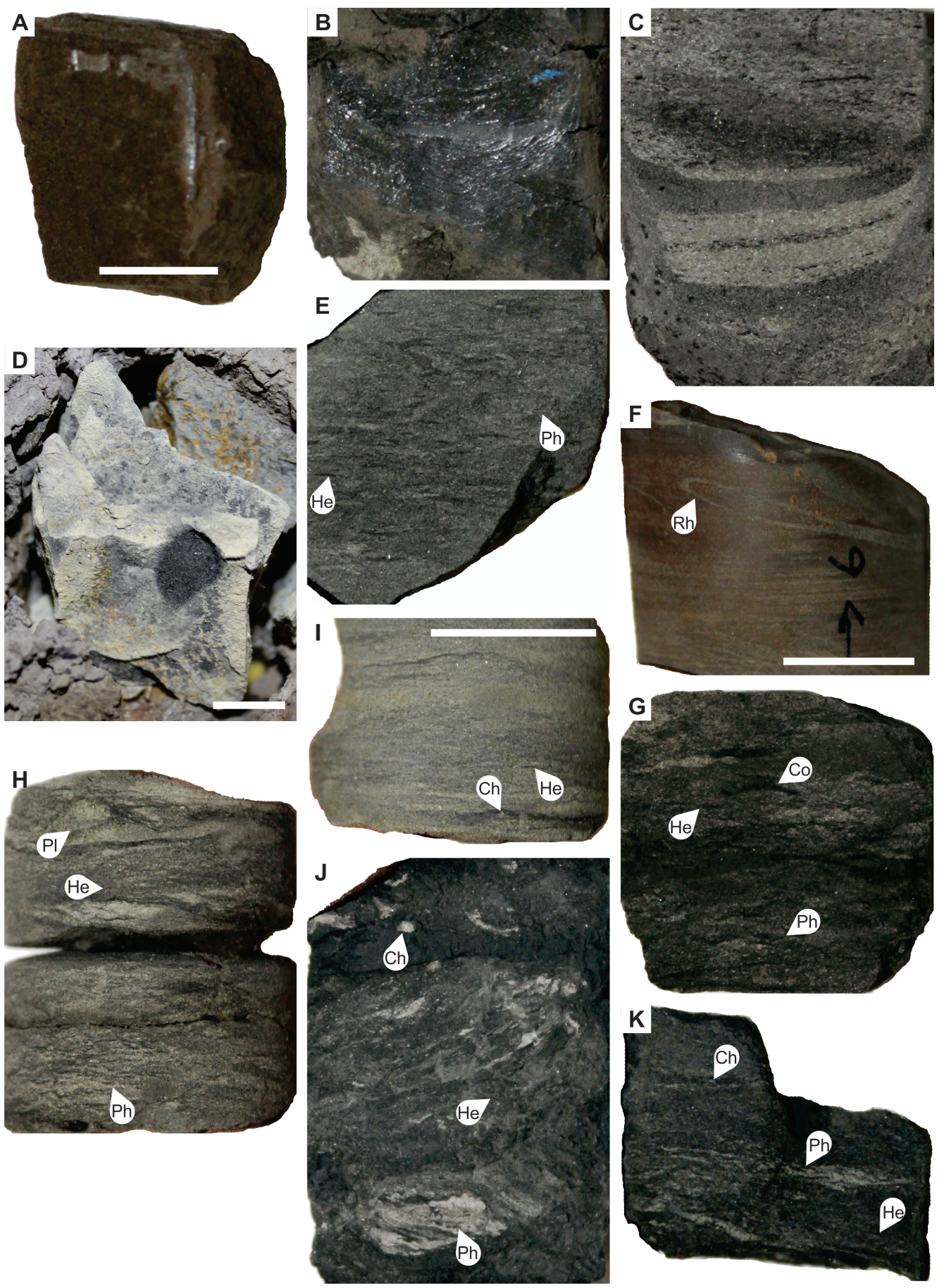


Figure 5 (previous page): Upper Cretaceous sedimentary bedrock samples from Home Bay (A-C), Scott Trough (D), and Buchan Trough (E-K). A) Mudstone from 82034-3. B) Mudstone from 82034-8. C) Muddy sandstone from 82034-10 with planar laminations and organic detritus. D) Shale fragment with sulphurous coating in piston core 80028-73. E) Bioturbated sandy mudstone with *Helminthopsis* (He) and *Phycosiphon* (Ph) from 78029-10. F) Sideritized silty mudstone with *Rhizocorallium* (Rh) from 78029-25. G) Homogenized silty mudstone from 78029-25 with *Cosmorhapha* (Co), *Helminthopsis* (He) and *Phycosiphon* (Ph). H) Muddy siltstone with extensive bioturbation including *Planolites* (Pl), *Helminthopsis* (He) and *Phycosiphon* (Ph) from 78029-26. I) Muddy siltstone with some planar lamination and trace fossils including *Chondrites* (Ch) and *Helminthopsis* from 78029-26. J) Deformed sandy mudstone with *Chondrites* (Ch), *Helminthopsis* (He) and *Phycosiphon* (Ph) from 80028-7. K) Bioturbated sandy mudstone from 80028-8 with *Chondrites* (Ch), *Helminthopsis* (He) and *Phycosiphon* (Ph). The full width of all drill cores is 2.54 cm, but the scale bars in 'A', 'D', 'F' and 'I' are 1 cm.

80028-73

A piston core located near the outer end of Scott Trough was collected during cruise 80028 at station 73. Numerous black shale bedrock fragments were observed from the lower part of the piston core (MacLean et al., 1981; MacLean et al., 2014). These bedrock fragments were found to be Campanian (MacLean et al., 1981), but later redefined as late Coniacian–early Santonian, probably late Coniacian (MacLean et al., 2014). Based on the rich assemblage of dinocysts, a marine setting was interpreted by MacLean et al. (2014). Additional observations from our study show that the dark grey shale fragments are fissile, relatively angular and range from less than 1 cm up to 5 cm across (Fig. 5D), suggesting transport over a short distance. The shale fragments also have a yellow, sulfurous coating. The host mud is medium brown-grey and contains no other clasts, except one granitic granule. Based on our lithological results and previous palynological data, a shelfal setting is most likely as nearshore marine settings tend to have dinocyst assemblages characterized by few taxa.

78029-10

A 19 cm drill core of dark grey, calcareous siltstones and organic-rich silty mudstones with glauconite and siderite was collected in Buchan Trough, at 78029-10 (MacLean and Falconer, 1979; MacLean et al., 2014). This bedrock was initially determined to be Late Cretaceous (Williams, pers. comm. in MacLean and Falconer, 1979), and later refined to Campanian (MacLean et al., 1981). However, MacLean et al. (2014) further revised the age designation to Late Coniacian. The paleoenvironment was presumed to be probably neritic (MacLean and Falconer, 1979; MacLean et al., 1981). Our analysis further revealed that the dark grey, silty mudstone is completely bioturbated, with marine trace fossils including: *Helminthopsis*, *Phycosiphon*, and lesser *Chondrites* (Fig. 5E). We suggest that the setting was outer shelf based on the intense bioturbation comprising predominantly grazing traces of the *Zoophycos* Ichnofacies and the fine-grained lithology.

78029-25

Adjacent to 78029-10, the drill core from station 25 is composed of 18 cm of dark grey, calcareous siltstones and organic-rich, silty mudstones with glauconite and siderite (MacLean and Falconer, 1979; MacLean et al., 2014). This sample was dated as Upper Cretaceous (Williams, pers. comm. in

MacLean and Falconer, 1979), Campanian (MacLean et al., 1981), and then later revised to late Coniacian–Santonian (MacLean et al., 2014). Similar to 78029-10, the setting was thought to be probably neritic (MacLean and Falconer, 1979; MacLean et al., 1981). We further describe the silty mudstone as non-calcareous and containing very fine-grained sandstone laminae with load structures (Fig. 5F, G). The mudstone is locally bioturbated with up to 90% reworking by marine trace fossils such as: *Helminthopsis*, *Phycosiphon*, *Cosmorhapse* (Fig. 5G), *Rhizocorallium* (Fig. 5F), and *Chondrites*. We suggest that the paleoenvironment was in the proximal part of the outer shelf due to the degree of silt content, rare organic detritus, and also the presence of deposit-feeding traces in addition to grazing traces, comprising a distal *Cruziana* Ichnofacies.

78029-26

Nearby to stations 10 and 25, a substantial bedrock sample was collected at 78029-26: 71 cm of dark grey, calcareous siltstones and organic-rich silty mudstones with glauconite and siderite (MacLean and Falconer, 1979; MacLean et al., 2014). The age has been interpreted as Upper Cretaceous (Williams, pers. comm. in MacLean and Falconer, 1979), Campanian (MacLean et al., 1981), and was later revised to late Coniacian–Santonian (MacLean et al., 2014). A probable neritic setting was again postulated for this drill core (MacLean and Falconer, 1979; MacLean et al., 1981). We further observe that the muddy siltstones are slightly friable and non-calcareous, with rare planar and wavy lamination, local sandy or silty horizons, rare organic detritus, and carbonaceous mudstone laminae (Fig. H, I). The siltstones are locally bioturbated with 10–80% reworking, and trace fossils include: *Phycosiphon*, *Helminthopsis*, *Planolites*, *Cosmorhapse*, and *Chondrites*. The trace fossil suite comprises a moderately stressed expression of the distal *Cruziana* Ichnofacies (i.e. having reduced diversity and lower abundance of trace fossils) dominated by grazing and deposit-feeding structures. Our results suggest a distal prodelta setting based on incomplete homogenization of the sediment, the sedimentary features indicating wave reworking, the stressed trace fossil suite (MacEachern et al., 2005), and carbonaceous mudstone laminae that may indicate hyperpycnal flows.

80028-7

Slightly west of the samples collected in 1978 in Buchan Trough, drill core 80028-7 sampled 44 cm of dark grey, calcareous siltstones and organic-rich silty mudstones with glauconite and siderite (Fig. 1) (MacLean, 1980; MacLean et al., 2014). The age was determined to be late Coniacian–early Santonian by MacLean et al. (2014), but no paleoenvironmental interpretation has been previously published. In the present study, we further note that the dark grey, silty mudstone fragments are moderately consolidated and non-calcareous. They also contain rare planar and wavy laminations, rare soft-sediment deformation features, and rare trace fossils including: *Phycosiphon*, *Helminthopsis*, and *Chondrites* (Fig. 5J). Overall bioturbation is only locally present, but can comprise up to 50% of the sediment. The trace fossil suite is consistent with the *Zoophycos* Ichnofacies typical of outer shelf conditions, but represents a low diversity and low abundance of traces, more typical of brackish or environmentally stressed settings (Pemberton et al., 2001). Here, the paleoenvironment

is interpreted as prodeltaic based on the fine-grained lithology, soft-sediment deformation indicating high-sedimentation rates, and the incomplete reworking by infaunal activity.

80028-8

Only a 4 cm bedrock drill core was recovered around the same location as 80028-7 at station 8, with a similar lithology: dark grey, calcareous siltstones and organic-rich silty mudstones with glauconite and siderite (MacLean, 1980; MacLean et al., 2014). Also, as in station 7, the age was found to be late Coniacian–early Santonian (MacLean et al., 2014), and no paleoenvironment interpretation was given. Our analyses indicate that the dark grey mudstone is moderately consolidated and non-calcareous with very fine-grained sandstone lenses, rare planar and wavy laminations, and soft-sediment deformation (Fig. 5K). Locally, there is 10–60% bioturbation, with trace fossils including: *Helminthopsis*, *Phycosiphon*, *Planolites*, *Chondrites*, and fugichnia. The trace fossil suite is consistent with the distal *Cruziana* Ichnofacies dominated by grazing traces and fewer deposit-feeding structures, but reworking is limited and suggests environmental stress. Similar to station 7, we interpret 80028-8 to have been deposited in a prodeltaic setting based on the fine-grained lithology, incomplete reworking by infaunal activity, and soft-sediment deformation features.

Paleogene Rocks in the Cumberland Basin Area

Three drill core samples of lower Paleogene rocks were recovered in the Cumberland Basin area, including one very close to the 74026Phase4-39 sample of possible Early Cretaceous age (Table 4; Fig. 1).

80028-108

Near Cumberland Basin, along the southwestern edge of the Davis Strait High, 80028-108 sampled 18 cm of mudstone-siltstone (MacLean, 1980) to calcareous siltstone (MacLean et al., 1982). This rock was determined to be Early Eocene and deposited in a marine setting based on the presence of dinocysts (Williams, pers. comm. in MacLean et al., 1982). Despite the previous interpretations, we found the sample to be a moderately-consolidated, muddy, dark grey-brown, very fine-grained sandstone, rather than siltstone. In addition, we observe rare loading structures and planar laminations, but there appears to be significant deformation or mottling of the sediment (Fig. 6A). In terms of the trace fossil assemblage, we observe only possible *Helminthopsis*. The poor condition of the drill core does not permit a conclusive interpretation of the paleoenvironment. However, a marine setting, as indicated by the palynomorph assemblage, combined with the lithology and possible presence of *Helminthopsis*, may indicate a distal inner shelf paleoenvironment.

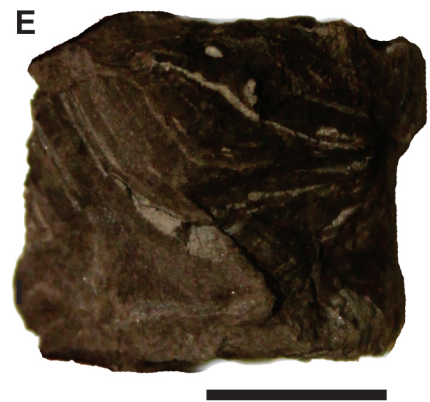
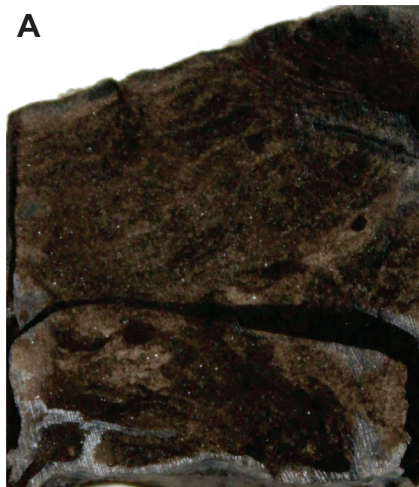


Figure 6 (previous page): Paleogene sedimentary bedrock samples from the Cumberland Basin area (A-E) and Scott Trough (F-I). A) Deformed muddy sandstone from 80028-108. B) Convolute-bedded silty sandstone with bedding parallel to the length of the core. *Helminthopsis* (He) is also present in 80028-109. C) Another sample of 80028-109 with bedding perpendicular to the length of the core with *Helminthopsis* (He). D-E) Deformed silty mudstone with microfaults from 80028-118. F) Dredge sample from 77027-9 showing the grey calcareous concretion with organic detritus. G) Mudstone with sulphurous coating from dredge sample 78029-22. H) Mudstone fragments from 88028-49 showing a consistent lithology. I) Mudstone with abundant carbonate cement and cone-in-cone structures from 80028-58. The full width of all drill cores is 2.54 cm, but the scale bars in 'E', 'F', 'G', and 'H' are 1 cm.

80028-109

In close proximity to the above-mentioned sample, a 29 cm drill core of mudstone-siltstone (MacLean, 1980) or calcareous siltstone (MacLean et al., 1982) was collected from 80028-109. This material was determined to be Early Eocene (Williams, pers. comm. in MacLean et al., 1982), but the age was later revised to Danian–Selandian (Paleocene) with reworked Early Cretaceous spores and Late Cretaceous dinocysts (MacLean et al., 2014). MacLean et al. (2014) further identified the paleoenvironment of deposition as inner neritic. We determined that the drill core is medium brown, silty, very fine-grained sandstone that is non-calcareous with minor organic detritus and rare, medium- to coarse-grained sand grains (Fig. 6B, C). Some bioturbation was observed (locally up to 20% of the rock) with *Helminthopsis* and possible *Rhizocorallium*. Notably, laminae appear horizontal in only one fragment near the top of the bedrock interval, and all other fragments exhibit vertical to sub-vertical or deformed laminae. We interpret this to reflect extensive convoluted bedding. Organic-rich laminae and the sandy lithology suggest a nearshore setting. The presence of *Helminthopsis* indicates a marine setting, but likely restricted marine based on the paucity of trace fossil diversity and abundance, and the convoluted bedding indicates a setting where sedimentation rates were high. Overall the evidence would suggest a delta front setting, which agrees with the inner neritic interpretation from palynological results.

80028-118

To the west of stations 108 and 109, the drill core at station 118 was collected during cruise 80028 and sampled 65 cm of dark grey to black, silty mudstone that is poorly lithified, mottled, with an apparent chaotic appearance and strong, petroliferous odour with bubbles emanating from the core upon recovery (MacLean, 1980; MacLean and Srivastava, 1981; MacLean et al., 1982). The initial age of the strata was thought to be Late Paleocene to Early Eocene (Williams, pers. comm. in MacLean et al., 1982), but was later revised to Paleocene (Williams, unpublished in MacLean et al., 2014). No previous paleoenvironmental interpretation was made. Our results indicate that this is a grey-brown, silty mudstone that is friable, moderately consolidated, non-calcareous, and contains light coloured, very fine-grained sandstone layers. Overall, the strata are heavily deformed with convoluted bedding and microfaults throughout, including vertical and overturned laminae (Fig. 6D, E). Based on the lithology and significant deformation of the sediment, likely a function of high sedimentation rates and sediment instability, we interpret 80028-118 to reflect a prodeltaic setting.

Paleogene Rocks in the Scott Trough

Four samples of Paleogene age bedrock were collected in Scott Trough during three different cruises and include drill core and dredge materials (Table 4; Fig. 1).

77027-9

The dredge sample at station 9 collected during cruise 77027 was reported as a calcareous concretion (boulder size), with mainly fine-grained calcite, silt- to sand-sized quartz grains and other detrital material including fossil fragments (MacLean, 1978). The concretion was further thought to have been derived from a shale interval based on the diagenetic characteristics (Jansa, pers. comm. in MacLean, 1978). The age of the rock was interpreted as Late Eocene (Williams, pers. comm. in MacLean, 1978), and then revised to Late Eocene–Early Oligocene (MacLean and Williams, 1983). A neritic depositional setting was postulated by MacLean (1978). We find the sample to be a dark grey, calcareous mudstone concretion that reacts strongly with hydrochloric acid (Fig. 6F). Rare, dark brown-black, organic fragments are present and may be the possible fossil fragments identified previously. The rock also contains scattered silt-sized quartz grains, local possible siderite, and an overall concretionary appearance with a pale brown-grey exterior. We did not determine further information that would help in interpretation of the paleoenvironmental setting, but it is likely marine based on similarities to 78029-22 described below.

78029-22

Station 22 from cruise 78029 collected another dredge sample containing several fragments. These were initially described as dark grey, calcareous sandstone concretions with plant remains (MacLean and Falconer, 1979; MacLean et al., 1981). The age was determined to be Late Eocene to Early Oligocene by MacLean et al. (1981), who postulated a shallow, nearshore depositional setting. We find the dredge sample to consist of multiple pebble to cobble-sized fragments as well as loose sediment. The lithology varies from buff-grey, muddy, very fine-grained sandstone to the more dominant lithology of sandy mudstone with faint laminations. The material is poorly lithified, covered in seabed mud, and has a sulphurous coating where fresh surfaces are present (Fig. 6G). Dark green mineralizations are also noted on fresh surfaces, and could indicate the presence of glauconite.

To reassess the age and paleoenvironment, which had not been previously well constrained, the sample was processed for palynomorphs. The challenge with this sample is the degree of reworking, as the ages of the reworked specimens span a considerable timeframe. However, the reworked palynomorphs provide some idea of the ages of the rocks once present in the vicinity of Scott Trough. The oldest dinocysts recovered were specimens of *Nyktericysta davisii*, which are indicative of an Aptian–Albian age. This species has been recorded predominantly from lagoonal to marginal marine paleoenvironments (Bint, 1986; Leckie and Singh, 1991); thus, suggesting the presence of lagoonal to marginal marine, Aptian–Albian strata presumably deposited in the area. Other reworked age diagnostic taxa in the sample were *Alterbidinium acuminatum*, *Apectodinium augustum*, *Apectodinium homomorphum*, *Chatangiella verrucosa*, *Chiropteridium galea*, *Glaphyrocysta ordinata*, *Laciniadinium arcticum*, *Oligosphaeridium pulcherrimum*, *Odontochitina costata* and *Svalbardella*

cooksoniae. *Chatangiella verrucosa* has its LO in the Coniacian, but *Laciniadinium arcticum* and *Odontochitina costata* have their LO in the Campanian. *Apectodinium augustum* occurs only at the Paleocene–Eocene boundary (Harland, 1979), thus denoting the Paleocene–Eocene Thermal Maximum (PETM). Although there are a few other specimens of *Apectodinium*, it seems unlikely that the source sediment would contain the abundances of *Apectodinium* found in lower latitudes (Crouch et al., 2001). However, Nøhr-Hansen et al. (2016) reported an abundance of this genus at the Paleocene–Eocene boundary in wells from offshore West Greenland. Although there is a diversity of reworked dinocysts, their numbers are low, accounting for only about 2% of the palynomorphs recorded from the dredge sample.

One revelation in terms of the age is the presence of *Svalbardella cooksoniae*, which is considered to be a marker for the Early Oligocene (Rupelian). There is some contention as to the age of the LO of this taxon. Costa *et al.* (1988) reported it from the Early Oligocene of northeast Europe, and Head and Norris (1989) placed the LO within the nannofossil zone NP 22, which is Early Oligocene (Rupelian). In two ODP holes in the Norwegian Sea, Williams and Manum (1999) placed the LO within the Rupelian at 31.9 Ma, based on the time scale of Goll (1989). Brinkhuis and Biffi (1993) and Brinkhuis (1994), by correlation with the magnetostratigraphy, determined the LO to equate with chron C12r, which again is Rupelian. Eldrett *et al.* (2004) correlated the LO based on the occurrence of the taxon in ODP Hole 913B with chron C13r at 33.6 Ma, almost at the Priabonian–Rupelian boundary. Accordingly, the youngest definitive age for the sample, based on the dinocysts, is Rupelian. Pollen are dominated by *Pinuspollenites*, which constitutes over 50% of the assemblage. Other pollen grains identified include *Alnipollenites* and *Betulaepollenites*, neither of which provides conclusive evidence for a post-Rupelian age. The sediments appear to have been deposited in deep water or a far from shore setting, which is supported by the dominance of *Pinuspollenites* (Mudie, 1982). This interpretation is more distal than that of MacLean et al. (1981). The lithology is consistent with a shelfal setting in which mud and sand are mixed and suggests distal inner to proximal outer shelf conditions.

80028-49

West of the above mentioned stations, drill core 80028-49 consists of 9 cm of what was initially described as questionable gravel by MacLean (1980) in the cruise report (Fig. 1). Despite the initial non-bedrock interpretation, we recognized lithological similarity to other samples collected from the region, such as those described above. The drill core includes numerous dark brown mudstone fragments that are non-calcareous and have a possible reddish stain (Fig. 6H).

After careful extraction of some bedrock fragments, they were processed for palynomorphs to see if it was possible to determine the age and paleoenvironment. Unlike the dredge sample from 78029-22, there were no Cretaceous palynomorphs, but there were some early Cenozoic pollen grains and numerous early Cenozoic dinocysts. The oldest palynomorph was the pollen *Momipites leffingwellii*, which has previously been recorded from the Early Paleocene (Nichols and Ott, 1978; Nichols, 2003).

Dinocysts identified include *Apectodinium homomorphum*, *Apectodinium quinquelatum*, *Cleistosphaeridium elegantulum*, *Cleistosphaeridium diversispinosum*, *Cleistosphaeridium palmatum*, *Deflandrea oebisfeldensis*, *Deflandrea phosphoritica*, *Hystrichosphaeridium tubiferum*, and *Thalassiphora delicata*. There were a surprising number of specimens of the dinocyst genus *Phthanoperidinium*. The composition of the dinocyst assemblage seems to be indicative of a Ypresian to early Lutetian age as indicated by the presence of *Hystrichosphaeridium tubiferum* (Williams et al., 2004). However, several specimens of the peridiniacean dinocyst *Phthanoperidinium* recorded from the sample support an early Lutetian age since the genus has rarely been recorded from the Ypresian (Williams et al., 2004; Williams et al., 2017). Based on the relative abundance of genus *Phthanoperidinium*, we interpret the paleoenvironment to have been inner neritic. This is supported by the relatively high abundance of acritarchs, commonly typical of closer-to-shore paleoenvironments (Staplin, 1961).

80028-58

Near station 49, a drill core of 10 cm of limestone, thought to be from the Cretaceous or Cenozoic sequence was collected at station 58 during the 80028 cruise (Levy and MacLean, 1981; MacLean et al., 1981; Harrison et al., 2011). We describe this core as dark grey-brown, carbonate-cemented mudstone with cone-in-cone structures, and abundant stylolites (Fig. 6I). The material is lithologically similar to that of dredge 77027-9, which is of Paleogene age, but we have no information from the sedimentology to interpret a depositional setting. This core interval does not span the full width of the core barrel, and thus may not be from in-situ bedrock.

Pliocene to Recent Rocks in the Western Davis Strait Region

Younger Cenozoic (Pliocene to Recent) rocks were also collected during two GSC cruises in 1976 and 1977 from near the mouth of Cumberland Sound and offshore Resolution Island and Hall Peninsula as primarily drill cores and one sample within a piston core (Table 4; Fig. 1).

76029-16

Outboard of the mouth of Cumberland Sound, drill core 76029-16 collected 44 cm of semi-consolidated sandstone, poorly sorted, with calcareous mudstone and foraminifera (MacLean and Falconer, 1977). The age was determined as Pliocene to Recent with reworked Aptian–Cenomanian, Senonian–Early Paleocene, and Eocene palynomorphs (Gradstein and Williams, pers. comm. in MacLean and Falconer, 1977). In terms of the paleoenvironment of deposition, a shallow, open shelf was previously postulated based on foraminifera (Gradstein, pers. comm. in MacLean and Falconer, 1977). We further describe the material as medium brown-grey, very fine-grained, sandy siltstone with very coarse sand to granules throughout and some subangular to subrounded pebbles (Fig. 7A, B). The bedding is massive and the cementation is calcareous. The subangular to subrounded clasts of varying origin suggest ice-rafting, and the lack of other sedimentary features indicates a distal marine, possibly shelfal setting where suspension settling dominated.

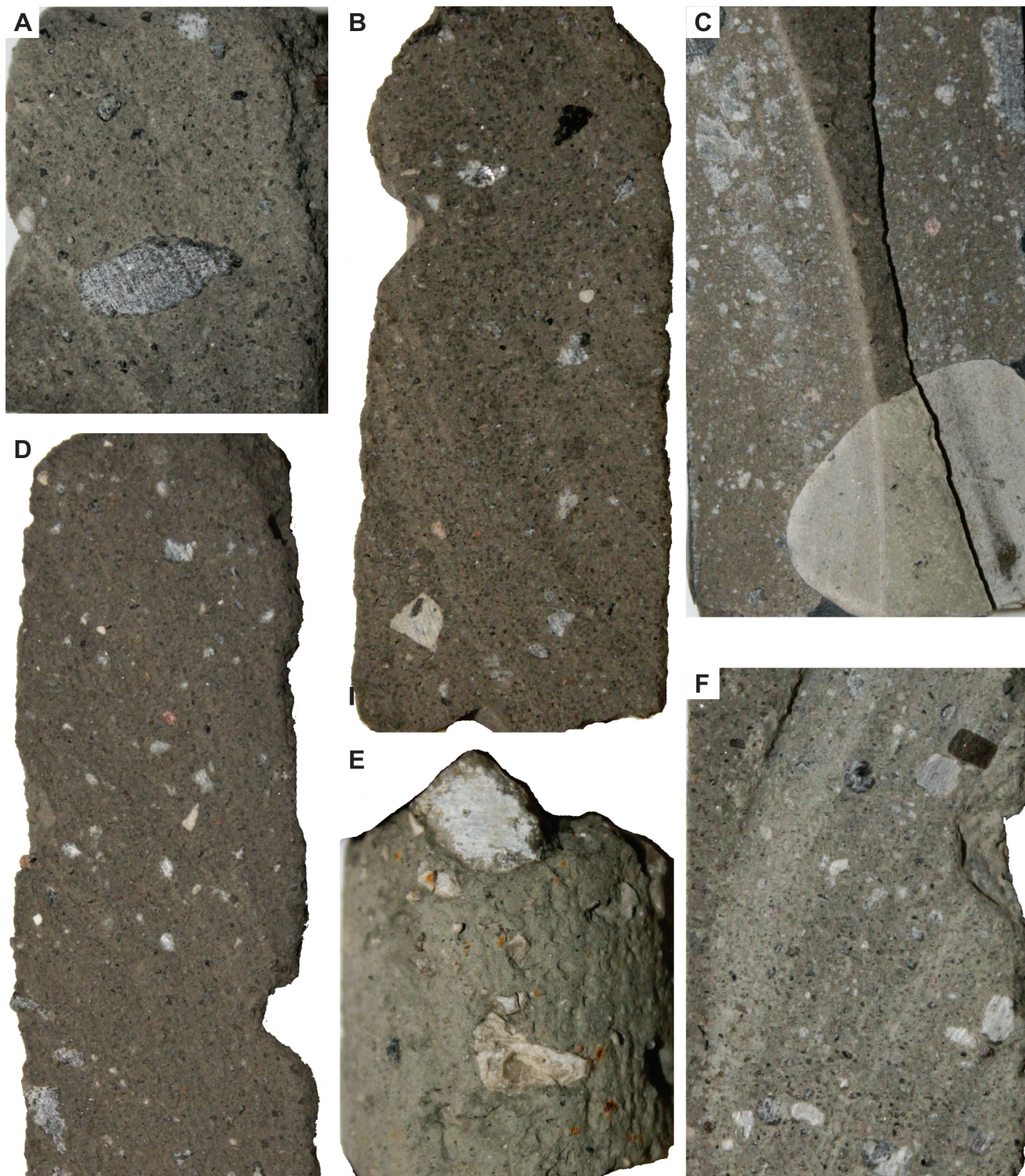


Figure 7: Pliocene to Recent sedimentary bedrock core samples from the western Davis Strait area. A-B) Sandy siltstone with coarser grains and small pebbles from 76029-16. C-D) Sandy siltstone with coarser grains and small pebbles, including both rounded and angular shapes from 76029-16A. E) Sandy siltstone with coarser grains and small pebbles from 77027-27. F) Sandy siltstone with coarser grains and small pebbles from 76029-6A. The full width of all drill cores is 2.54 cm.

76029-16A

Similar to station 16, 76029-16A comprises 33 cm of semi-consolidated sandstone, poorly sorted with calcareous mudstone and foraminifera (MacLean and Falconer, 1977). Again, the age was found to be Pliocene to Recent with reworked Aptian–Cenomanian, Senonian–Early Paleocene, and Eocene palynomorphs (Gradstein and Williams, pers. comm. in MacLean and Falconer, 1977). The foraminiferal assemblage indicates a shallow, open shelf setting (Gradstein, pers. comm. in MacLean and Falconer, 1977). We find the sample to be a medium grey-brown siltstone with variously sized sand grains throughout. The bedding is massive and cementation is calcareous with subangular to subrounded pebbles and granules (Fig. 7C, D). Overall the rock is only moderately consolidated. Like that of station 16, the subangular to subrounded clasts of varying origin suggest ice-rafting, and the lack of other sedimentary features indicates a distal marine, possibly shelfal setting where suspension settling dominated.

77027-27

East of Brevoort Island, station 27 of cruise 77027 collected a 15 cm drill core of semi-consolidated sandstone (MacLean, 1978). No age or paleoenvironment has been determined for this material. In this study, we describe the drill core as composed of fine-grained sandy, light grey-buff siltstone that is poorly sorted with pebbles and granules throughout (mostly comprised of light brown limestone like that of the Ordovician carbonates sampled in the region; Fig. 7E; Jansa, 1976). The cementation is calcareous and the rock is moderately consolidated. We recorded one shell fragment. Based on its similarity to the samples recovered at stations 76029-16 and 16A, this drill core is likely of similar age and depositional setting.

76029-6A

A 53 cm drill core of semi-consolidated sandstone that is poorly sorted, with calcareous mudstone, foraminifera, and plant fragments was recovered offshore Hall Peninsula (MacLean and Falconer, 1977). A Pliocene to Recent age was determined for the drill core, from the presence of reworked Paleozoic and Cretaceous palynomorphs (Gradstein and Williams, pers. comm. in MacLean and Falconer, 1977). Based on the foraminifera, a brackish, shallow marine setting was postulated (Gradstein, pers. comm. in MacLean and Falconer, 1977). In our study, we describe the rock as light brown-grey, sandy siltstone with very coarse grains to small pebbles throughout (Fig. 7F). The cementation is calcareous and bedding is massive. Like that of the above stations, the subangular to subrounded clasts of varying origin suggest ice-rafting, and the lack of other sedimentary features indicates a distal marine, possibly shelfal setting where suspension settling dominated.

77027-32

Closer to Frobisher Bay, at station 32 of cruise 77027, an 11.5 cm bedrock sample was recovered from within a piston core (MacLean, 1977). The rock was described as semi-consolidated sandstone with scattered gravel fragments (MacLean, 1978). The age was found to be Pliocene–Quaternary with deposition in an open marine setting (Gradstein pers. comm., in MacLean, 1978). Only vials of sand grains, light grey, well to poorly sorted including fine-upper to small granules, remain of the

sample, as well as one vial of floated foraminifera. The presence of foraminifera indicate a marine setting, but we could not gain any further insights.

SUMMARY

The basalt drill core samples collected in the western Davis Strait region are primarily aphanitic to amygdaloidal and secondarily vesicular and porphyritic. They appear to reflect solidification of lava near the base of flows and also near flow tops where vesicles are more abundant. However, one drill core (80028-92) may be related to subaqueous formation. Despite their widespread occurrences along the Davis Strait High and offshore Cape Dyer where onshore volcanic rocks have been mapped and described (Clarke and Upton, 1971), the basalts are relatively similar across the region. Two ages of 62.9 Ma and 55.1 Ma (Danian and early Ypresian; Williamson et al., 2000) from the drill cores offshore Cape Dyer and in central Davis Strait, respectively, may indicate a progressive seaward younging of the basalt interval.

A total of seven samples record Lower Cretaceous deposition in the Cumberland Sound area and offshore Paallavik (island). The sample collected outside the mouth of Cumberland Sound (74026Phase4-39) could not be re-evaluated, but is in close proximity to much younger rocks from cruise 76029 that contain extensive reworked palynomorphs (Gradstein and Williams, pers. comm. in MacLean and Falconer, 1977), which may explain the Cretaceous age determined for this sample. The three bedrock samples in Cumberland Sound appear to be generally Aptian–Albian, but possibly as old as Barremian. All three reflect quiet-water settings that may be nonmarine to possibly marginal marine, perhaps floodplain or lagoonal deposits. North of the sound, offshore Paallavik (island), three additional drill cores were collected. The mudstones are Aptian to late Albian in age and reflect nonmarine to possibly shallow marine conditions. We interpret quiet-water settings that could include fluvial floodplain or lagoonal settings. The extensive sandstone core collected from this same region is undated, and we interpret it to reflect fluvial or shallow marine deposits. These rocks resemble the Neocomian to Aptian onshore sandstones on Qaqulluit (island), studied by Burden and Langille (1990, 1991), which are also of nonmarine to shallow marine origin.

Upper Cretaceous rocks dominate the collected bedrock samples from the eastern Baffin Island margin. In the Home Bay area, the mudstones, siltstones and sandstones appear to be late Santonian to early Campanian in age and were deposited in a quiet-water shelf setting with the sandstone reflecting deltaic conditions. Shale fragments in a piston core near the seaward end of Scott Trough are late Coniacian–early Santonian, probably late Coniacian. The shales were deposited in a quiet-water, marine setting, likely on the shelf. Further north in Buchan Trough, mudstones dominate the lithology and are late Coniacian–early Santonian in age. From trace fossil analyses, these were deposited in prodelta, distal prodelta, proximal outer shelf and outer shelf settings.

In the Cumberland Sound region, three Paleogene drill core samples were collected ranging in age from Danian–Selandian to Early Eocene. These drill cores consist of mudstones and sandstones, but all display a similar deformed, convolute bedded and laminated fabric. We find the depositional settings to be distal inner shelf, prodelta and delta front. In Scott Trough, four bedrock samples of Paleogene and presumed Paleogene rocks were recovered. These include mudstones, a sandstone and a calcareous mudstone concretion. Only three were dated and found to be Lutetian, Late Eocene–Early Oligocene, and no older than Rupelian, reflecting Middle Eocene to Lower Oligocene rocks exposed near or at the seafloor. The depositional settings for some samples are neritic or shelfal and distal inner shelf to outer shelf.

In the region drilled, the youngest bedrock samples are Pliocene to Recent in age, but the drill cores are relatively well consolidated, differentiating them from very recent sediment. All the samples are overwhelmingly similar, consisting of sandy siltstone with coarser sand grains and small pebbles. The depositional setting is likely shelfal with ice-rafting.

The 17 basalt and 29 sedimentary bedrock samples collected from near the seafloor by the GSC provide some of the only insights into the Mesozoic–Cenozoic subsurface stratigraphy of the western Davis Strait and eastern Baffin Island margin, an area that is otherwise poorly sampled. Analysis of these samples provides key information to help constrain the lithology, age, and paleoenvironments of deposition during Mesozoic–Cenozoic rifting.

ACKNOWLEDGEMENTS

The authors would like to thank Brian MacLean for his insights on many of the original samples and drill core process. Also, thanks to Nikole Bingham-Koslowski for her thorough review of an earlier version of this report. Thanks to Kate Jarrett for her help with the viewing and sub-sampling process. The authors also thank Georgia Pe-Piper for her insights on the basalt intervals. A special thanks to Russ Harms from Global Geolabs for his in-kind processing of one of the palynology samples. Also, thanks to Lori Campbell for her help with the coordination of the palynology slides.

OVERSIZED TABLES

Table 1: GSC drill core samples of basement bedrock in the western Davis Strait area and on the eastern Baffin Island margin.

Table 2: GSC drill core samples of Ordovician pre-rift sedimentary bedrock on the southeastern Baffin Island margin.

Table 3: GSC drill core samples of basalt bedrock in the western Davis Strait area (*= see text for references).

Table 4: GSC seabed samples of Mesozoic–Cenozoic sedimentary bedrock in the western Davis Strait area and on the eastern and southeastern Baffin Island margin (*= see text for references).

REFERENCES

- Bingham-Koslowski, N., 2018. Descriptions of drill cores and thin sections from lower Paleozoic strata, southeastern Baffin Island shelf, Nunavut; Geological Survey of Canada, Open File 8409, 78 p. <https://doi.org/10.4095/308354>
- Bint, A.N., 1986. Fossil ceratiaceae: a restudy and new taxa from the mid-Cretaceous of the western interior, USA; *Palynology*, v. 10, p. 135–180.
- Brinkhuis, H., 1994. Late Eocene to Early Oligocene dinoflagellate cysts from the Priabonian type-area (northeast Italy): biostratigraphy and paleoenvironmental interpretation; *Palaeogeography, Palaeoclimatology, Palaeoecology*, v.107, p.121–163, pl.1–7.
- Brinkhuis, H. and Biffi, U., 1993. Dinoflagellate cyst stratigraphy of the Eocene/Oligocene transition in central Italy; *Marine Micropaleontology*, v.22, p. 131–183, pl. 1–10.
- Burden, E.T. and Langille, A.B., 1990. Stratigraphy and sedimentology of Cretaceous and Paleocene strata in half-grabens on the southeast coast of Baffin Island, Northwest Territories; *Bulletin of Canadian Petroleum Geology*, v. 38, p. 185-196.
- Burden, E.T. and Langille, A.B., 1991. Palynology of Cretaceous and Tertiary strata, northeast Baffin Island, Northwest Territories, Canada: Implications for the history of rifting in Baffin Bay; *Palynology*, v. 15, p. 91-114.
- Clarke, D.B. and Upton, B.G.J., 1971. Tertiary basalts of Baffin Island: Field relations and tectonic setting; *Canadian Journal of Earth Sciences*, v. 8, p. 248-258.
- Costa, L.I., Manum, S.B., and Meyer, K.-J., 1988. The regional distribution of dinoflagellates; correlation of the interregional zonation with the local zones and regional lithostratigraphy, Great Britain/Norway, The Viking Graben; *in The Northwest European Tertiary Basin: Results of the International Geological Correlation Programme*, (ed.) R. Vinken; Project No. 124, *Geologisches Jahrbuch, Reihe A, Heft 100*, p. 321–330.
- Crouch, E.M., Heilmann-Clausen, C., Brinkhuis, H., Morgans, H.E.G., Rogers, K.M., Egger, H., and Schmitz, B., 2001. Global dinoflagellate event associated with the late Paleocene thermal maximum; *Geology*, v. 29, no., 4, p. 315–318.
- Dafoe, L.T. and Williams, G.L., 2020. Palynostratigraphic and integrated paleoenvironmental assessment of the ODP Site 645 corehole in Baffin Bay, offshore eastern Canada; Geological Survey of Canada, Open File 8701, 1 .zip file.

Dickie, K., Keen, C.E., Williams, G.L., and Dehler, S.A., 2011. Tectonostratigraphic evolution of the Labrador Margin, Atlantic Canada; *Marine and Petroleum Geology*, v. 28, p. 1663-1675.
doi:10.1016/j.marpetgeo.2011.05.009

Eldrett, J.S., Harding, I.C., Firth, J.V., and Roberts, A.P., 2004. Magnetostratigraphic calibration of Eocene–Oligocene dinoflagellate cyst biostratigraphy from the Norwegian-Greenland Sea; *Marine Geology*, v. 204, p. 91–127.

General Bathymetric Chart of the Oceans (GEBCO), 2014. GEBCO 2014 Grid; International Hydrographic Organization and the Intergovernmental Oceanographic Commission (of UNESCO). www.gebco.net [accessed May, 2015]

Goll, R.M., 1989. A synthesis of Norwegian-Greenland Sea biostratigraphies: ODP Leg 104 on the Vøring Plateau; *in* Ocean Drilling Program; (ed.) O. Eldholm, J. Thiede, E. Taylor, C. Barton, K. Bjørklund, U. Bleil, P. Ciesielski, A. Desprairies, D. Donnally, C. Froget, R. Goll, R. Henrich, E. Jansen, L. Krissek, K. Kvenvolden, A. Letturay, D. Love, P. Lynse, T. McDonald, P. Mudie, L. Osterman, L. Parson, J.D. Phillips, A. Pittenger, G. Qvale, G. Schönharting, and L. Viereck; *Proceedings, Scientific Results*, v.104, Ocean Drilling Program, College Station, Texas, U.S.A., p.777–826.

Gregersen, U., Knutz, P.C., Nøhr-Hansen, H., Sheldon, E., and Hopper, J.R., 2019. Tectonostratigraphy and evolution of the West Greenland continental margin; *Bulletin of the Geological Society of Denmark*, v. 67, p. 1–21. <https://2dggf.dk/publikationer/bulletin/bulletin-volume-67-2019/>

Harland, R., 1979. The *Wetzeliiella (Apectodinium) homomorphum* plexus from the Palaeogene/earliest Eocene of north-west Europe. In: Fourth International Palynology Conference, Lucknow, 1976-1977, *Proceedings*, v. 2, p. 59–70.

Harrison, J.C., Brent, T.A., and Oakey, G.N., 2011. Baffin Fan and its inverted rift system of Arctic eastern Canada: stratigraphy, tectonics and petroleum resource potential; *in* Arctic Petroleum Geology, (ed.) A.M. Spencer, A.F. Embry, D.L. Gautier, A.V. Stoupakova, and K. Sørensen; Geological Society, London, *Memoirs*, v. 35, p. 595–626. doi: 10.1144/M35.40

Head, M.J. and Norris, G., 1989. Palynology and dinocyst stratigraphy of the Eocene and Oligocene in ODP Leg 105, Hole 647A, Labrador Sea; *Ocean Drilling Program, Proceedings, Scientific Results*, Leg 105, p. 515–550, pl. 1–13.

Jansa, L.F., 1976. Lower Paleozoic radiolarian-bearing limestones from the Baffin Island shelf; Geological Survey of Canada, *Report of Activities, Part B, Paper 76-1B*, p. 99-105.

Keen, C.E., Dickie, K., and Dafoe, L.T., 2018a. Structural characteristics of the ocean-continent transition along the rifted continental margin, offshore central Labrador; *Marine and Petroleum Geology*, v. 89, p. 443-463.

Keen, C.E., Dickie, K., and Dafoe, L.T., 2018b. Structural evolution of the rifted margin off northern Labrador: The role of hyperextension and magmatism; *Tectonics*, v. 37, p. 1955–1972.
<https://doi.org/10.1029/2017TC004924>

Klose, G.W., Malterre, E., McMillan, N.J., and Zinkan, C.G., 1982. Petroleum exploration offshore southern Baffin Island, northern Labrador Sea, Canada; *Canadian Society of Petroleum Geologists, Memoir 8*, p. 233–244.

Larsen, L.M., Heaman, L.M., Creaser, R.A., Duncan, R.A., Frei, R., and Hutchison, M., 2009. Tectonomagmatic events during stretching and basin formation in the Labrador Sea and the Davis Strait: evidence from age and composition of Mesozoic to Palaeogene dyke swarms in West Greenland; *Journal of the Geological Society, London*, v. 166, p. 999-1012.

Leckie, D.A. and Singh, C., 1991. Estuarine deposits of the Albian Paddy Member (Peace River Formation) and lowermost Shaftesbury Formation, Alberta, Canada; *Journal of Sedimentary Petrology*, v. 61, no. 5, p. 825–849.

Levy, E.M. and MacLean, B., 1981. Natural hydrocarbon seepage at Scott Inlet and Buchan Gulf, Baffin Island Shelf: 1980 update; *Geological Survey of Canada, Scientific and Technical Notes, in Current Research, Part A, Paper 81-1A*, p. 401-403.

MacEachern, J.A., Bann, K.L., Bhattacharya, J.P., and Howell, C.D. Jr., 2005. Ichnology of deltas: organism responses to the dynamic interplay of rivers, waves, storms and tides; in, *River Deltas—Concepts, Models, and Examples*, (ed.) L. Giosan and J.P. Bhattacharya; *SEPM Special Publication No. 83*, p. 49-85.

MacLean, B., 1977. Hudson 77-027; *Geological Survey of Canada, cruise report* (available through the Expedition Database; <https://ed.gdr.nrcan.gc.ca>), 27 p.

MacLean, B., 1978. Marine geological-geophysical investigations in 1977 of the Scott Inlet and Cape Dyer-Frobisher Bay areas of the Baffin Island continental shelf; *Geological Survey of Canada, Current Research, Part B, paper 79-1B*, p. 231-244.

MacLean, B., 1980. Cruise report C.S.S. Hudson 80-028; *Geological Survey of Canada, cruise report* (available through the Expedition Database; <https://ed.gdr.nrcan.gc.ca>), 31 p.

MacLean, B., 1985. Preliminary report of cruise activities – CSS Hudson 85-027. Geological Survey of Canada, cruise report (available through the Expedition Database; <https://ed.gdr.nrcan.gc.ca>), 54 p.

MacLean, B. and Falconer, R.K.H., 1977. Baffin Island shelf – shallow corehole drilling, 1976; Geological Survey of Canada, Paper 77-1B, Report of Activities, Part B, p. 125-127.

MacLean, B. and Falconer, R.K.H., 1979. Geological/geophysical studies in Baffin Bay and Scott Inlet – Buchan Gulf and Cape Dyer-Cumberland Sound areas of the Baffin Island Shelf; Geological Survey of Canada, Current Research, Part B, Paper 79-1B, p. 231-244.

MacLean, B. and Srivastava, S.P., 1981. Petroliferous core from a diapir east of Cumberland Sound, Baffin Island; Geological Survey of Canada, Scientific and Technical Notes, Current Research, Part A, Paper 81-1A, p. 399-400.

MacLean, B. and Williams, G.L., 1983. Geological investigations of Baffin Island shelf in 1982; Geological Survey of Canada, Current Research, Part B, Paper 83-1R, p. 309-315.

MacLean, B., Jansa, L.F., Falconer, R.K.H., and Srivastava, S.P., 1977. Ordovician strata on the southeastern Baffin Island shelf revealed by shallow drilling; Canadian Journal of Earth Sciences, v. 14, p. 1925-1939.

MacLean, B., Falconer, R.K.H., and Clarke, D.B., 1978. Tertiary basalts of western Davis Strait: bedrock core samples and geophysical data; Canadian Journal of Earth Sciences, v. 15, p. 773-780.

MacLean, B., Falconer, R.K.H., and Levy, E.M., 1981. Geological, geophysical and chemical evidence for natural seepage of petroleum off the northeast coast of Baffin Island; Bulletin of Canadian Petroleum Geology, v. 29, p. 75-95.

MacLean, B., Srivastava, S.P., and Haworth, R.T., 1982. Bedrock structures off Cumberland Sound, Baffin Island shelf: core sample and geophysical data; *in* Arctic Geology and Geophysics, (ed.) A.F. Embry and H.R. Balkwill; Canadian Society of Petroleum Geologists, Memoir 8, Proceedings of the Third International Symposium on Arctic Geology, p. 279-295.

MacLean, B., Jennings, A., and Blakeney, C., 1986. Bedrock and surficial geology of Cumberland Sound, N.W.T.; Geological Survey of Canada, Current Research, Part B, Paper 86-1B, p. 605-615.

MacLean, B., Williams, G., and Zhang, S., 2014. New insights into the stratigraphy and petroleum potential of the Baffin shelf's Cretaceous rocks; Bulletin of Canadian Petroleum Geology, v. 62, p. 289-310.

Mudie, P.J., 1982. Pollen distribution in recent marine sediments; offshore eastern Canada; *Canadian Journal of Earth Sciences*, v. 19, no. 4, p. 729–747.

Nichols, D.J., 2003. Palynostratigraphic framework for age determination and correlation of the nonmarine Lower Cenozoic of the Rocky Mountains and Great Plains region; *in* *Cenozoic systems of the Rocky Mountain region*, (ed.) R.G. Reynolds and R.M. Flores); The Rocky Mountain Section SEPM (Society for Sedimentary Geology), Denver, Colorado, p. 107-133.

Nichols, D.J. and Ott, H.L., 1978. Biostratigraphy and evolution of the *Momipites-Caryapollenites* lineage in the early Tertiary in the Wind River Basin, Wyoming; *Palynology*, v.2, p. 94–112.

Nøhr-Hansen, H., Williams, G.L., and Fensome, R.A., 2016. Biostratigraphic correlation of the western and eastern margins of the Labrador—Baffin Seaway and implications for the regional geology; *Geological Survey of Denmark and Greenland Bulletin*, v. 37, 74 p.

Oakey, G.N. and Chalmers, J.A., 2012. A new model for the Paleogene motion of Greenland relative to North America: Plate reconstructions of the Davis Strait and Nares Strait regions between Canada and Greenland; *Journal of Geophysical Research*, v. 117, B10401. doi:10.1029/2011JB008942

Pemberton, S.G., Spila, M., Pulham, A.J., Saunders, T., MacEachern, J.A., Robbins, D., and Sinclair, I.K., 2001. Ichnology & Sedimentology of Shallow to Marginal Marine Systems: Ben Nevis & Avalon Reservoirs, Jeanne d’Arc Basin; *Geological Association of Canada, Short Course*, 15, 343 p.

Roest, W.R. and Srivastava, S.P., 1989. Sea-floor spreading in the Labrador Sea: A new reconstruction; *Geology*, v. 17, no. 11, p. 1000–1003. [https://doi.org/10.1130/0091-7613\(1989\)017<1000:SFSITL>2.3.CO;2](https://doi.org/10.1130/0091-7613(1989)017<1000:SFSITL>2.3.CO;2)

Srivastava, S.P., 1974. Cruise report Hudson 74-026, Phase IV; Geological Survey of Canada, unpublished cruise report, 26 p.

Srivastava, S.P., MacLean, B., Macnab, R.F., and Jackson, H.R., 1982. Davis Strait: structure and evolution as obtained from a systematic geophysical survey; *in* *Arctic Geology and Geophysics*, (ed.) A.F. Embry and H.R. Balkwill; Canadian Society of Petroleum Geologists, Memoir 8, Proceedings of the Third International Symposium on Arctic Geology, p. 267-278.

Srivastava, S.P., Arthur, M., Clement, B., et al., 1987. Proc. ODP, Init. Repts., 105: College Station, TX (Ocean Drilling Program). doi:10.2973/odp.proc.ir.105.1987

Staplin, F.L., 1961. Reef controlled distribution of Devonian microplankton in Alberta. *Palaeontology*, v.4, no.3, p.392–424.

Storey, M., Duncan, R.A., Pedersen, A.K., Larsen, L.M., and Larsen, H.C., 1998. Ar-40/Ar-39 geochronology of the west Greenland tertiary volcanic province; *Earth and Planetary Science Letters*, v. 160, p. 569–586.

Storey, M., Duncan, R.A., and Tegner, C., 2007. Timing and duration of volcanism in the North Atlantic Igneous Province: implications for geodynamics and links to the Iceland hotspot; *Chemical Geology*, v. 241, no. 3-4, p. 264-281. <https://doi.org//10.1016/j.chemgeo.2007.01.016>

Suckro, S.K., Gohl, K., Funck, T., Heyde, I., Schreckenberger, B., Gerlings, J., and Damm, V., 2013. The Davis Strait crust—a transform margin between two oceanic basins; *Geophysical Journal International*, v. 193, no. 1, p. 78–97. doi:10.1093/gji/ggs126

Williams, G.L. and Manum, S.B., 1999. Oligocene-early Miocene dinocyst stratigraphy of Hole 985A, Norwegian Sea; *in* Proceedings ODP Leg 162, (ed.) M.E. Raymo, E. Jansen, P. Blum, and T.D. Herbert; Ocean Drilling Program, College Station, Texas, U.S.A., p. 99–109.

Williams, G.L., Brinkhuis, H., Pearce, M.A., Fensome, R.A. and Weegink, J.W., 2004. Southern Ocean and global dinoflagellate cyst events compared: index events for the Late Cretaceous–Neogene; *in* Ocean Drilling Program Proceedings, (ed.) N.F. Exon et al.; Scientific Results, v.189, p. 1–98.

Williams, G.L., Fensome, R.A., and MacRae, R.A., 2017. The Lentin and Williams index of fossil dinoflagellates 2017 edition. American Association of Stratigraphic Palynologists Contributions Series, no. 48, 1096 p.

Williamson, M.-C., Villeneuve, M., Jackson, R., and MacLean, B., 2000. Argon Geochronology of basaltic rocks recovered from drilling on the Baffin Island shelf and in the Davis Strait, Eastern Canada; *American Geophysical Union*, v. 81, p. 1361 (abstract).

Zhang, S., 2013. Rock Eval6 and Vitrinite Reflectance Data from Baffin Island Shelf and Hudson Strait; Geological Survey of Canada, Open File 7341, 32 p. doi:10.4095/292376

TABLE 1

| Expedition | Year | Original Station No. | General Location | Latitude (N) | Longitude (W) | Sample Type | Length of bedrock core (cm) | Water Depth (m) | Rock Type | Description | Other Analyses |
|-------------|------|----------------------|-------------------------|--------------|---------------|-------------|-----------------------------|-----------------|----------------------|---|--|
| 75009PHASE5 | 1975 | 9 | Cumberland Sound Region | 63.19 | -63.10 | Rock Drill | 66 | 176 | Metamorphic (Gneiss) | Biotite gneiss (Jansa, 1976; MacLean et al., 1977) | |
| 75009PHASE5 | 1975 | 9A | Cumberland Sound Region | 63.18 | -63.08 | Rock Drill | 158 | 176 | Metamorphic (Gneiss) | Biotite gneiss (Jansa, 1976; MacLean et al., 1977) | Age: 1604 +/- 40 and 1611 +/- 39 (K-Ar age; MacLean et al., 1977) |
| 76029 | 1976 | 49 | Cumberland Sound Region | 63.18 | -62.77 | Rock Drill | 104 | 218 | Metamorphic (Gneiss) | Quartz-biotite-feldspar gneiss (MacLean and Falconer, 1977) | Compressional wave velocity: 5.0-6.1 km/s (average 5.5 km/s; from four samples from stations 49 and 50A; MacLean and Falconer, 1977) |
| 76029 | 1976 | 50A | Northern Saglek Basin | 61.56 | -64.38 | Rock Drill | 172 | 194 | Metamorphic (Gneiss) | Light grey, garnetiferous gneiss (MacLean and Falconer, 1977) | Compressional wave velocity: 5.0-6.1 km/s (average 5.5 km/s; from four samples from stations 49 and 50A; MacLean and Falconer, 1977) |
| 77027 | 1977 | 25 | Cumberland Sound Region | 64.02 | -63.93 | Rock Drill | 370 | 197 | Metamorphic (Gneiss) | Biotite gneiss (MacLean, 1978) | |
| 77027 | 1977 | 29 | Cumberland Sound Region | 62.97 | -63.01 | Rock Drill | 108 | 182 | Metamorphic (Gneiss) | Garnet-biotite gneiss (MacLean, 1978) | |
| 78029 | 1978 | 19 | Scott Trough | 71.40 | -70.05 | Rock Drill | 61 | 267 | Metamorphic | Metamorphic rock (MacLean and Falconer, 1979; MacLean et al., 1981) | |
| 78029 | 1978 | 20 | Scott Trough | 71.39 | -70.06 | Rock Drill | 73 | 267 | Metamorphic | Metamorphic rock (MacLean and Falconer, 1979; MacLean et al., 1981) | |
| 78029 | 1978 | 34 | Home Bay area | 70.21 | -66.71 | Rock Drill | 95 | 118.9 | Metamorphic | Metamorphic rock (MacLean and Falconer, 1979) | |
| 78029 | 1978 | 44 | Cape Dyer Region | 66.39 | -61.11 | Rock Drill | 76 | 164 | Metamorphic | Metamorphic rock (MacLean and Falconer, 1979) | |
| 78029 | 1978 | 47 | Cape Dyer Region | 66.40 | -61.11 | Rock Drill | 72 | 166.4 | Metamorphic | Metamorphic rock (MacLean and Falconer, 1979) | |
| 78029 | 1978 | 57 | Cape Dyer Region | 65.45 | -63.12 | Rock Drill | 232 | 195.7 | Metamorphic | Metamorphic rock (MacLean and Falconer, 1979) | |
| 78029 | 1978 | 60 | Cape Dyer Region | 65.43 | -62.72 | Rock Drill | 144 | 124.4 | Metamorphic | Metamorphic rock (MacLean and Falconer, 1979) | |
| 85027 | 1985 | 49 | Cumberland Sound Region | 65.03 | -65.55 | Rock Drill | 37 | 220 | Metamorphic (Gneiss) | Hornblend-pyroxene gneiss (MacLean et al., 1986) | |

TABLE 2

| Expedition | Year | Original Station No. | General Location | Latitude (N) | Longitude (W) | Sample Type | Length of bedrock core (cm) | Water Depth (m) | Rock Type | Description | Age | Paleoenvironment | Other Analyses |
|-------------|------|----------------------|-------------------------|--------------|---------------|-------------|-----------------------------|-----------------|-----------|--|--|--|----------------------------|
| 75009PHASE5 | 1975 | 4 | Cumberland Sound Region | 62.97 | -63.43 | Rock Drill | 137 | 157 | Limestone | Mottled, olive-grey, dolomitic limestone with bioturbation, peloids, flat-pebble breccia, and skeletal breccia (Jansa, 1976; MacLean et al., 1977; Bingham-Koslowski, 2018) | Ordovician (MacLean et al., 1977) | Intertidal to shallow subtidal with storm deposits (Jansa, 1976; MacLean et al., 1977); shallow water (Bingham-Koslowski, 2018) | TOC: 0.61 % (Zhang, 2013) |
| 75009PHASE5 | 1975 | 5 | Cumberland Sound Region | 63.27 | -63.91 | Rock Drill | 54 | 358 | Limestone | Massive, yellow-brown, skeletal wackestone to packstone, bioturbated with minor dolomite and diverse fossil types (Jansa, 1976; MacLean et al., 1977; Bingham-Koslowski, 2018) | Ordovician (Caradoc; MacLean et al., 1977) | Open marine, low-energy, deeper intralittoral setting (Jansa, 1976; MacLean et al., 1977); photic zone (Bingham-Koslowski, 2018) | TOC: 0.38 % (Zhang, 2013) |
| 75009PHASE5 | 1975 | 8A | Cumberland Sound Region | 63.22 | -63.46 | Rock Drill | 45 | 165 | Limestone | Yellow-brown, radiolaria-bearing, bituminous, micritic limestone with pervasive dolomitization and some fossil fragments and bioturbation (Jansa, 1976; Bingham-Koslowski, 2018) | Ordovician (Caradoc; MacLean et al., 1977) | Low-energy setting with poor oxygenation such as the outer shelf to epibathyal (Jansa, 1976; MacLean et al., 1977); deeper water (Bingham-Koslowski, 2018) | TOC: 2.685 % (Zhang, 2013) |
| 75009PHASE5 | 1975 | 8B | Cumberland Sound Region | 63.22 | -63.46 | Rock Drill | 83 | 165 | Limestone | Yellow-brown, radiolaria-bearing, bituminous, micritic limestone with pervasive dolomitization and some fossil fragments and mottling (Jansa, 1976; Bingham-Koslowski, 2018) | Ordovician (Caradoc; MacLean et al., 1977) | Low-energy setting with poor oxygenation such as the outer shelf to epibathyal (Jansa, 1976; MacLean et al., 1977); deeper water (Bingham-Koslowski, 2018) | TOC: 0.915 % (Zhang, 2013) |
| 77027 | 1977 | 28 | Cumberland Sound Region | 63.1979 | -63.01445 | Rock Drill | 100 | 179 | Limestone | Dark brown, micritic limestone with radiolaria casts and finely disseminated organic material, bioturbation, and fossil fragments (MacLean, 1978; Bingham-Koslowski, 2018) | Probably middle-late Ordovician based on similarities to previously cored material (MacLean, 1978) | Deeper water (Bingham-Koslowski, 2018) | |
| 77027 | 1977 | 26A | Cumberland Sound Region | 63.66 | -63.63 | Rock Drill | 83 | 373 | Limestone | Grey limestone with fine-grained calcite crystals, stylolites and some radiolarians (MacLean, 1978; Bingham-Koslowski, 2018) | Probably middle-late Ordovician based on similarities to previously cored material (MacLean, 1978) | Deeper water (Bingham-Koslowski, 2018) | TOC: 0.1 % (Zhang, 2013) |

TABLE 3

| Expedition | Year | Original Station No. | General Location | Latitude (N) | Longitude (W) | Sample Type | Length of bedrock core (cm) | Water Depth (m) | Rock Type | Interpretation from previous studies* | Interpretation from this study | Other Analyses |
|------------|------|----------------------|-------------------------------|--------------|---------------|-------------|-----------------------------|-----------------|-----------------------------------|---------------------------------------|--------------------------------|--|
| 76029 | 1976 | 21 | Offshore Cape Dyer | 65.92 | -60.31 | Rock Drill | 13 | 408 | Amygdaloidal basalt | Near the top of a basalt flow | Near the top of a basalt flow | |
| 76029 | 1976 | 22 | Offshore Cape Dyer | 65.90 | -60.34 | Rock Drill | 37 | 404 | Aphanitic to amygdaloidal basalt | Basalt flow | At depth within a basalt flow | Compressional wave velocity: 5.2-6.0 km/s (average 5.6 km/s; from eight samples from stations 22 and 47; MacLean and Falconer, 1977); 5.3 km/s (MacLean et al., 1978). |
| 76029 | 1976 | 47 | Offshore Cape Dyer | 66.38 | -60.84 | Rock Drill | 37 | 391 | Aphanitic and vesicular basalt | | Near the top of a basalt flow | Compressional wave velocity: 5.2-6.0 km/s (average 5.6 km/s (MacLean and Falconer, 1977) and 5.4 km/s (MacLean et al., 1978). Age: Late Cretaceous to early Tertiary (report to MacLean and Falconer (1977) on whole rock basalt using K-Ar age); 62.9 +/- 2.5 Ma (Danian; Ar-Ar age on whole rock basalt; Williamson et al., 2000). |
| 77027 | 1977 | 21 | Offshore Cumberland Peninsula | 65.57 | -59.04 | Rock Drill | 12 | 452 | Aphanitic basalt | | At depth within a basalt flow | |
| 77027 | 1977 | 21B | Offshore Cumberland Peninsula | 65.57 | -59.03 | Rock Drill | 12.5 | 457 | Aphanitic and porphyritic basalt | | At depth within a basalt flow | |
| 80028 | 1980 | 88 | Central Davis Strait | 66.48 | -57.86 | Rock Drill | 43 | 555 | Aphanitic basalt | | At depth within a basalt flow | |
| 80028 | 1980 | 89 | Central Davis Strait | 66.48 | -57.86 | Rock Drill | 27 | 560 | Aphanitic and amygdaloidal basalt | | Near the top of a basalt flow | |

TABLE 3 (continued)

| | | | | | | | | | | | | |
|-------|------|-----|-------------------------------|-------|--------|------------|------|-----|----------------------------------|--|--|---|
| 80028 | 1980 | 91 | Central Davis Strait | 66.76 | -57.77 | Rock Drill | 7.50 | 660 | Amygdaloidal to vesicular basalt | | Near the top of a basalt flow | |
| 80028 | 1980 | 92 | Central Davis Strait | 66.75 | -57.77 | Rock Drill | 16 | 648 | Aphanitic to brecciated basalt | | Possible subaqueous setting | 55.1 +/- 2.3 Ma (Ypresian; Ar-Ar age on whole rock basalt; Williamson et al., 2000) |
| 80028 | 1980 | 93 | Central Davis Strait | 66.50 | -57.49 | Rock Drill | 21 | 530 | Aphanitic basalt | | Possibly at depth within a basalt flow | |
| 80028 | 1980 | 94 | Central Davis Strait | 66.50 | -57.49 | Rock Drill | 17 | 530 | Aphanitic to vesicular basalt | | Near the top of a basalt flow | |
| 80028 | 1980 | 98 | Offshore Cumberland Peninsula | 65.56 | -59.15 | Rock Drill | 5 | 452 | Aphanitic basalt | | At depth within a basalt flow | |
| 80028 | 1980 | 99 | Offshore Cumberland Peninsula | 65.56 | -59.15 | Rock Drill | 17 | 455 | Aphanitic basalt | | At depth within a basalt flow | |
| 80028 | 1980 | 100 | Offshore Cumberland Peninsula | 65.56 | -59.14 | Rock Drill | 16 | 455 | Aphanitic basalt | | At depth within a basalt flow | |
| 80028 | 1980 | 106 | Cumberland Sound Region | 64.58 | -60.40 | Rock Drill | 18 | 367 | Aphanitic basalt | | At depth within a basalt flow | |
| 80028 | 1980 | 107 | Cumberland Sound Region | 64.59 | -60.39 | Rock Drill | 13 | 367 | Amygdaloidal basalt | | At depth within a basalt flow | |
| 82034 | 1982 | 21 | Central Davis Strait | 66.51 | -57.88 | Rock Drill | 14 | 569 | Aphanitic basalt | | At depth within a basalt flow | |

TABLE 4

| Expedition | Year | Original Station No. | General Location | Latitude (N) | Longitude (W) | Sample Type | Length of bedrock core (cm) | Water Depth (m) | Rock Type | Age(s) from previous studies* | Age from this study | Paleoenvironment from previous studies* | Paleoenvironment from this study | Other Analyses (Zhang, 2013) |
|-------------|------|----------------------|-------------------------|--------------|---------------|----------------------|-----------------------------|-----------------|--------------------------------|---|------------------------|---|--|------------------------------|
| 74026PHASE4 | 1974 | 39 | Cumberland Sound Region | 64.27 | -61.94 | Rock Drill | 18 | 287 | Sandstone | Late Albian-Cenomanian | | | | |
| 76029 | 1976 | 6A | Northern Saglek Basin | 62.31 | -62.19 | Rock Drill | 53 | 385 | Siltstone | Pliocene to Recent | | Brackish, shallow marine | Distal marine, possibly shelfal with ice-rafting | |
| 76029 | 1976 | 16 | Cumberland Sound Region | 64.33 | -62.04 | Rock Drill | 44 | 283 | Siltstone | Pliocene to Recent | | Shallow, open shelf | Distal marine, possibly shelfal with ice-rafting | |
| 76029 | 1976 | 16A | Cumberland Sound Region | 64.33 | -62.01 | Rock Drill | 33 | 285 | Siltstone | Pliocene to Recent | | Shallow, open shelf | Distal marine, possibly shelfal with ice-rafting | |
| 77027 | 1977 | 9 | Scott Trough | 71.33 | -70.37 | Dredge | | 567 | Calcareous mudstone concretion | Late Eocene; late Eocene-early Oligocene | | Neritic | Likely marine | |
| 77027 | 1977 | 27 | Cumberland Sound Region | 63.59 | -63.79 | Rock Drill | 15 | 219 | Siltstone | | | | Distal marine, possibly shelfal with ice-rafting | |
| 77027 | 1977 | 32 | Northern Saglek Basin | 61.96 | -63.47 | Piston Core (Cutter) | 11.5 | 475 | Sandstone | Pliocene-Quaternary | | Open marine | Marine setting | |
| 78029 | 1978 | 10 | Buchan Trough | 71.89 | -72.92 | Rock Drill | 19 | 310 | Mudstone | Late Cretaceous; Campanian; late Coniacian | | Probably neritic | Outer shelf | TOC: 0.89 % |
| 78029 | 1978 | 22 | Scott Trough | 71.32 | -70.40 | Dredge | | 550-640 | Sandstone | Late Eocene to early Oligocene | No older than Rupelian | Shallow, nearshore setting | Distal inner shelf to proximal outer shelf | |
| 78029 | 1978 | 25 | Buchan Trough | 71.91 | -72.90 | Rock Drill | 18 | 298 | Mudstone | Upper Cretaceous; Campanian; late Coniacian-Santonian | | Probably neritic | Proximal outer shelf | TOC: 0.51 % |

TABLE 4 (continued)

| | | | | | | | | | | | | | | |
|-------|------|-----|----------------------------|-------|--------|-------------|----|-------|-------------------------|---|----------|------------------|---|----------------------------|
| 78029 | 1978 | 26 | Buchan Trough | 71.90 | -72.94 | Rock Drill | 71 | 539.5 | Siltstone | Upper Cretaceous Campanian; revised to late Coniacian- Santonian | | Probably neritic | Distal prodelta | TOC: 0.63 % |
| 80028 | 1980 | 7 | Buchan Trough | 71.85 | -73.16 | Rock Drill | 44 | 562 | Mudstone | Late Coniacian-early Santonian | | | Prodelta | TOC: 1.71 % |
| 80028 | 1980 | 8 | Buchan Trough | 71.85 | -73.16 | Rock Drill | 4 | 585 | Mudstone | Late Coniacian-early Santonian | | | Prodelta | TOC: 1.66 % |
| 80028 | 1980 | 49 | Scott Trough | 71.26 | -70.61 | Rock Drill | 9 | 650 | Mudstone | | Lutetian | | Inner neritic | |
| 80028 | 1980 | 58 | Scott Trough | 71.27 | -70.68 | Rock Drill | 10 | 743 | Mudstone (carbonate) | | | | | TOC: 0.85 % |
| 80028 | 1980 | 73 | Scott Trough | 71.40 | -70.15 | Piston Core | | 432 | Shale | Campanian; late Coniacian-early Santonian, probably late Coniacian | | Marine | Quiet-water, likely shelfal setting | TOC: 1.61 %; Ro: 0.59 % |
| 80028 | 1980 | 81 | Paallavik (island) area | 67.27 | -62.15 | Rock Drill | 6 | 265 | Siltstone | Late Albian | | Nonmarine | Quiet-water setting, possibly floodplain | TOC: 2.64 % |
| 80028 | 1980 | 108 | Cumberland Sound Region | 64.59 | -60.61 | Rock Drill | 18 | 375 | Sandstone | Early Eocene | | Marine | Distal inner shelf | TOC: 1.84 % |
| 80028 | 1980 | 109 | Cumberland Sound Region | 64.59 | -60.61 | Rock Drill | 29 | 375 | Sandstone | Early Eocene; Danian-Selandian | | Inner neritic | Delta front | TOC: 1.38 % |
| 80028 | 1980 | 118 | Cumberland Sound Region | 64.28 | -61.93 | Rock Drill | 65 | 296 | Mudstone | Late Paleocene to early Eocene; Paleocene | | | Prodelta | |
| 82034 | 1982 | 3 | Home Bay | 68.87 | -65.66 | Rock Drill | 19 | 659 | Siltstone | Campanian; late Santonian-early Campanian | | Mid-shelf | Quiet-water setting | TOC: 2.58 % |
| 82034 | 1982 | 6 | Home Bay | 68.86 | -65.67 | Rock Drill | 1 | 530 | Siltstone | | | | | |
| 82034 | 1982 | 8 | Home Bay | 68.65 | -65.67 | Rock Drill | 15 | ? | Mudstone | Late Cretaceous; Santonian | | Marine setting | Quiet-water setting, likely shelfal | TOC: 3.74 % |
| 82034 | 1982 | 10 | Home Bay | 68.64 | -65.70 | Rock Drill | 17 | 460 | Sandstone | Late Cretaceous | | Marine setting | Deltaic | TOC: 5.73 %; Ro: 0.5 % |

TABLE 4 (continued)

| | | | | | | | | | | | | | | |
|-------|------|----|-------------------------|-------|--------|-------------|-------------------------------|-----|-----------|--|--|---|--|-------------------------|
| 82034 | 1982 | 16 | Paallavik (island) area | 67.26 | -62.19 | Rock Drill | 6 | 368 | Mudstone | Albian; Aptian to middle Albian | | Nonmarine, but possible proximity to a shoreline | Quiet-water setting, possibly floodplain or lagoonal | |
| 82034 | 1982 | 38 | Cumberland Sound Region | 64.82 | -64.58 | Rock Drill | 6 | 724 | Mudstone | Aptian-Cenomanian; Early Cretaceous, could be reworked | | | Quiet-water setting | TOC: 6.44 %; Ro: 0.5 % |
| 85027 | 1985 | 23 | Paallavik (island) area | 67.25 | -62.18 | Rock Drill | 117 | ? | Sandstone | Possibly Aptian-early Albian like sandstones on nearby Qaulluit (island) | | | Fluvial or shallow marine | TOC: 7.84 %; Ro: 0.44 % |
| 85027 | 1985 | 31 | Cumberland Sound Region | 65.39 | -65.51 | Piston Core | Bedrock fragments in sediment | 896 | Shale | Early Cretaceous, Barremian-Albian, possibly Aptian to middle Albian | | Nonmarine, possible proximity to a shoreline or marginal marine | Quiet-water setting, possibly floodplain or lagoonal | |
| 85027 | 1985 | 48 | Cumberland Sound Region | 65.06 | -65.21 | Rock Drill | 9 | 890 | Mudstone | Barremian-Aptian; Aptian-Albian | | Nonmarine, possible proximity to a shoreline | Quiet-water setting, possibly floodplain or lagoonal | TOC: 5.24 %; Ro: 0.42 % |